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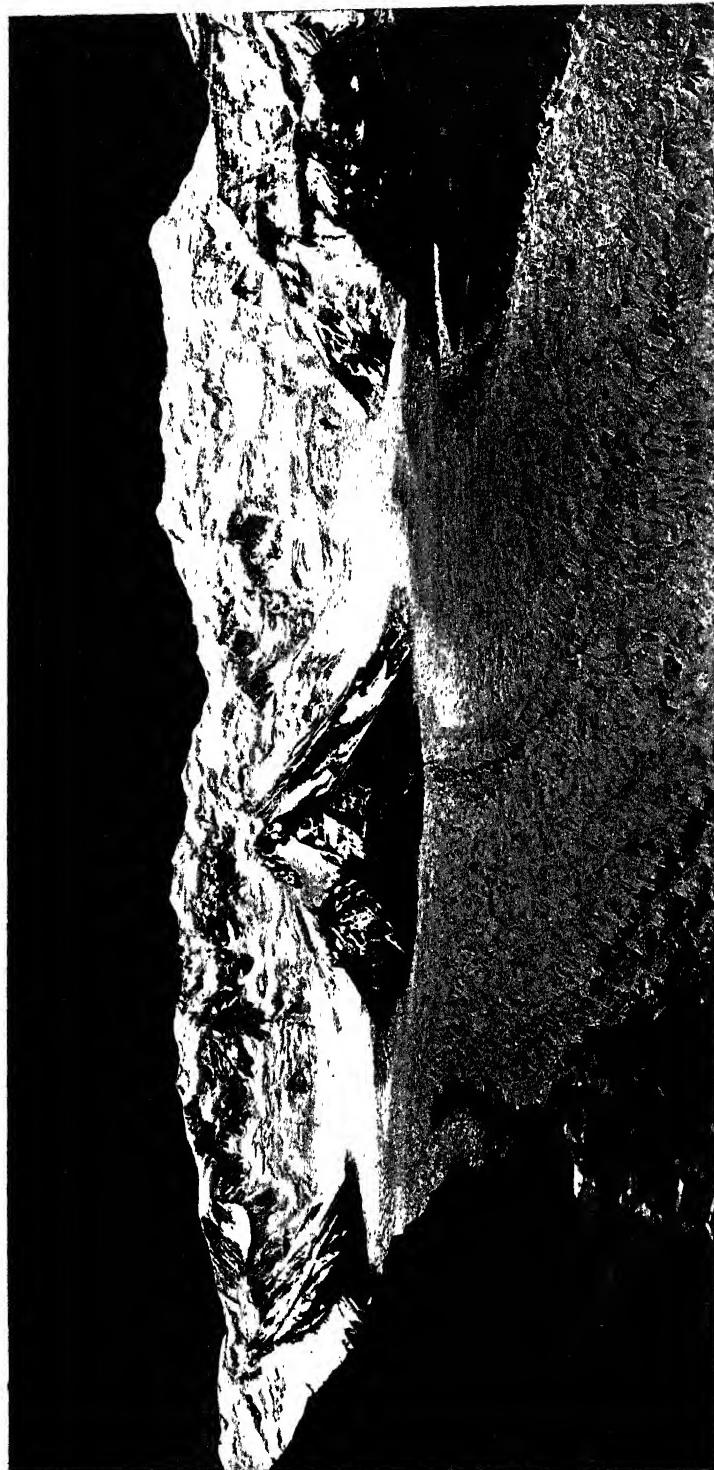
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AP SARASAS GROUP MUZZTAGH-KARAKORAM AND HEAD OF KYAGAR GLACIER

RECORDS OF THE
SURVEY OF INDIA
Vol. XXII.

**EXPLORATION OF
THE SHAKSGAM VALLEY
AND AGHIL RANGES
1926**



BY MAJOR KENNETH MASON, M.C., R.E.
SUPERINTENDENT SURVEY OF INDIA; FOUNDER'S
GOLD MEDALLIST OF THE ROYAL GEOGRAPHICAL
SOCIETY

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P R E F A C E

I have much pleasure in congratulating Major Mason on behalf of the Survey of India on the success of this difficult exploration, and on the judgment, skill and excellent organization with which it was carried out. It has been a matter of great satisfaction to us all that His Majesty the King Emperor has been pleased to award the Founder's Gold Medal of the Royal Geographical Society to Major Mason for this work and for his previous success in carrying our geodetic triangulation across the Pāmirs in 1913, thus connecting it with that of Russia for the first time (*vide* Records of the Survey of India Volume VI). This honour has been particularly well earned, since Major Mason has not only distinguished himself as a Himalayan explorer, but has also spent a great deal of labour in studying the whole history of Himalayan exploration, which is now much better known to us all as a result of his very thorough and patient research.

Geographically the area involved in this exploration is of special interest, as it forms the apex of the great divide between the drainage of Central Asia and the Indian Ocean. Here we find the sources of the Yārkand flowing northwards and of tributaries flowing southwards to the Indus. The interesting character of the drainage can best be studied from the diagram opposite page 72, which also shows us the arrangement of the largest glaciers in the world outside the polar regions.

The proper name to be assigned to this area is thus a matter of considerable interest, and has been carefully studied and discussed by Major Mason (*vide* p. 74 and also remarks in the Introduction on p. 1). From these discussions it appears quite clear that "*the Karakoram Range*" is really a misnomer which has arisen through a series of misunderstandings at a time when the geography of the area was practically unknown. It is generally felt to be undesirable to change names which have thus crept into common usage, however unsuitable they may be; Major Mason therefore suggests a compromise which would apply the name "*Karakoram Himālaya*" to the whole neighbourhood; thus using the name Karakoram in a vaguer and wider sense than at present to cover every part of the area in which it has ever been applied, without assigning it to particular ranges for which it is definitely unsuitable. The only alternative would presumably be to defy current usage on the ground that it is now known to be wrong and to devise some more suitable

name. There are also minor questions as to the designation of the ranges, for which Major Mason suggests the names *Aghil-Karakoram*, *Muztagh-Karakoram*, and *Kailas-Karakoram*, in which the name *Karakoram* is merely a concession to previous usage, while Major Mason regards *Kailas* as equally unsuitable for this part of the range to which it has been applied.

I do not consider this department should decide questions which depend so much on international usage. We can only assist by publishing the suggestions of our best experts, and then hope the Royal Geographical Society, which includes all the principal geographers and explorers interested, will find an early opportunity of discussing these suggestions and arriving at decisions, in which case we shall be happy to accept them and incorporate them on our future maps.

I attach below further remarks prepared by Major Mason concerning events which have taken place since the main report was sent to press.

*Calcutta,
The 17th Novr. 1928.*

E. A. TANDY,
Brigadier,
Surveyor General of India.

POSTSCRIPT BY MAJOR MASON

The first point to be noted is that there now seems a fair chance of our having an account of Sir Filippo De Filippi's expedition to the Karakoram in 1914, in the English language. This district, as may be seen from the brief history of exploration given on pages 3-5, has been visited by several explorers of continental countries, and there is a danger that the writings of some of them may be overlooked, when written in their own languages.

Since the drafting of this report Mr. H.F. Montagnier of the Alpine Club has organized a small expedition to enter the Shaksgam valley from the Hunza side. He was however not permitted to cross the Shingshal pass, and a very interesting piece of exploration in the Ghujerâb and Chapursân valleys of Hunza has been carried out by him, Captain C. J. Morris, and Torabaz Khan of the Survey of India. This project of crossing from Hunza into the Shaksgam therefore still awaits the explorer who can overcome the initial difficulties. The great "Snow Lake" at the head of the Biafo glacier, discovered by Godwin Austen in 1861, has never yet been surveyed, and will afford some future explorer a very interesting piece of work. From the Vissers' explorations among the head glaciers of the Shingshal there seems to be a probability of an easy pass between them and the Snow Lake. The connection of this area with the "Shahzad Mir" or "Crevasse" glacier, discovered by Sir Francis Younghusband in 1889, and its relation with the Nobundi Sobundi glacier of Godwin Austen are also unknown.

Further east I should mention that the Italians have again organised an expedition to explore and survey the remaining blanks of the Muztāgh-Karakoram and Shaksgam valley in the K² vicinity. H. R. H. the Duke of Spoleto, who will lead this expedition in 1929, intends if possible to cross the eastern watershed of the Baltoro glacier, somewhere between K² and the "Golden Throne", descend by the Gasherbrum or Urdok glaciers to the Shaksgam valley and return to the Baltoro glacier by Sir Francis Younghusband's route of 1887, by the Sarpo Laggo glacier and Muztāgh pass. His Royal Highness has already in the summer of this year established his depot of supplies at Askole, the nearest village to the Baltoro glacier.

There are still many parts well within our borders in the Karakoram area that await the surveyor. The early reconnaissance atlas sheets of the Survey of India were not from detailed surveys in the modern sense, and Godwin Austen himself has told me that his surveyors were expressly instructed not "to waste time on barren areas above 15,000 ft." In spite of this warning many of the officers of the Survey of India carried their detailed surveys far above this limit. On the other hand lack of time and funds are responsible for many of the existing inaccuracies among the snows of the great ranges. The watersheds east and west of the Nubra valley are as yet very imperfectly explored and though they are shown on the old atlas sheets, they were sketched from so great a distance as to be almost imaginary. A few travellers, Dr. Longstaff, Dr. Arthur Neve, Collins, the Vissers, Gompertz and perhaps a few others have indicated the presence of large glaciers lying near these watersheds. They have climbed peaks not shown on any existing map. Here are situated two fields of almost virgin ground for the climber, and *absolutely new* ground for the modern surveyor.

Since I wrote the story of my expedition one of the Kumdun glaciers has again advanced and blocked the Upper Shyok, forming a lake to the north of it. It is significant of the growing interest being taken in these mighty ranges today, that the newspapers and the public became thoroughly alarmed; and the imaginary bursting of the dam was almost heard in Fleet Street. The basins of the Kumdan-Aktāsh glaciers are in the Muztāgh-Karakoram range. Here lies an area which could be rapidly and accurately surveyed by the Stereographic method described in Chapter VIII.

There is one last matter of interest to all Himalayan students. *The Himalayan Club* has been formed this year in India, with headquarters at Simla, to promote the better knowledge of the Himalaya through literature, art, science and sport. It is to be hoped that this Club will receive all the support it deserves.

Calcutta,
November 1928.

K. M.

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INTRODUCTION

B EYOND the main axis of the Himālaya, but part of the great *Himālayan Barrier* of Northern India, lies the complex mountain system of the Karakoram. The name in Turki means *Black Gravel*, and was first applied by traders to the high pass on the ancient caravan route between India and Yārkand. Moorcroft, that mysterious and somewhat disappointed pioneer, was the first to apply the name generally to the ranges of mountains which separate the Indus and Tarim basins, a little over a hundred years ago; and this inappropriate name has been, for some years, restricted by geographers to the whitest, iciest range of mountains outside Polar regions. It seems a pity; for to call black, *white*, and white, *black*, impresses nobody with our sense of sagacity.

On this range lie some of the highest mountains of our earth, true peaks, spotlessly white: the second highest, K², 28,250 feet above sea-level, and at least five others above 26,000 feet. The range extends unbroken to the west and north-west, bounding on the north the great glaciers, the Siachen, the Baltoro, the Biafo, and the Hispar, the first of which has no rival outside sub-Polar regions; and on the west it terminates at the gorge of the Hunza river, above Baltit.

The Karakoram pass is not on this range, though it lies on the Central Asian watershed. It is in the barren area beyond the range, the *Black Gravel* area, the area of broken, crushed and disintegrating shale. It lies on the eastern edge of the block of country we set out to explore, and is, itself, well-known and well-trodden.

South of the range of the great peaks, which I shall henceforth call the Muztāgh-Karakoram,* there is another range, parallel to it, and extending for much the same distance in either direction, though more cut into by the glaciers draining southwards. The two bear a close affinity. South of them lie the various ranges of the Himālaya, which, stretching across the north of India from one end to the other, supports Everest and Kinchinjunga.

It is small wonder that beyond these great ranges, lies an arid land, for moisture-laden currents flowing from the south or west

* See Chap. VII.

are checked. Even the ice-streams north of the Muztāgh-Karakoram are smaller than those on the south, and beyond them the land is still more thirsty. The country rapidly assumes a more Tibetan aspect. Vegetation and animal life have to struggle hard for a scant livelihood, and if man exists at all, he must be a wayfarer or nomad.

Nevertheless, there are traditions of routes across the barren area, though no certainty until the valley of the Yārkand river in Raskam is reached. Here are signs of a once more or less settled people; a small community who worked some ancient mines, and scratched from the soil a bare existence. And through this valley passed, and passes still, the winter trade-route by Kökyār to Yārkand.

I need not mention the earliest references to routes across this area.* They are uncertain and difficult to follow, being derived from native hearsay, but it seems certain that at one time,—it is impossible to say when, for almost every direct mention speaks of *formerly*—there has been a way across it, between the Karakoram pass and the Muztāgh pass of Sir Francis Younghusband.

It may be well to review briefly the advance of topographical knowledge of the Karakoram, of the sources of the Yārkand river, and of the Aghil and western section of the K'un-lun ranges. This sketch may fitly commence with the reconnaissance surveys of Captain Godwin Austen and Mr. E. C. Ryall, of the Survey of India, in 1861. So little was known at that time that these officers imagined that they had surveyed to the K'un-lun crest, whereas in reality their surveys did not extend to that of the Muztāgh-Karakoram.

The traveller Hayward in 1868 explored one of the upper branches of the Yārkand river, west of the Karakoram pass; but he did not survey this valley to its head, nor did he explore its tributaries. And it is not till now that we can place definitely on our map the ravine at the head of which “a pass leads (according to Hayward) across the Karakoram range into the Nubra valley in Ladak, and to Chorbut in Baltistan.”†

Hayward added that this pass “is apparently at a very high elevation, probably not less than 19,000 feet above the sea, and is closed for nine months in the year by snow. It is impracticable for anything but foot travellers, and perhaps for yaks; and although not in use for many years, was formerly traversed by Baltis, carrying their own loads of merchandise into Yārkand. This pass appears also to have been used by the Kalmuk Tartars in their successful

* These references are summed up by Colonel Wood in the Appendix to his “Explorations in the Eastern Karakoram and the upper Yārkand Valley,” p. 31 *sqq.*

† *Journal of the Royal Geographical Society*, Vol. 40, 1868. Hayward was of course unaware of the existence of two ranges, the Aghil and Muztāgh-Karakoram.

invasions of Ladak and Tibet towards the close of the seventeenth century."

On the Ladakh side, about the same time, the following report was collected and seriously incorporated in the annals of the Government of India: "Another stream called the Yarma or Nobra flows from above the Changlung, which was anciently traversed by a route to Khapulung. This route was closed by the people of Nobra, who, by throwing in of charcoal, helped the formation of iceblocks, which obstructed the passage altogether."

Hayward's map showed tributaries of the Raskam-Yarkand river flowing directly from the Karakoram range; and the line of this range, owing to its inaccessibility from all directions, was shown many miles to the south of its true position.

It was in 1887, that Sir Francis Younghusband, then a lieutenant in the King's Dragoon Guards, made his famous journey from Pekin across Asia to India. In September of that year he stood upon the Aghil pass and saw below him the previously unsuspected valley of the Shaksgam. Beyond, apparently barring all progress, ranged the chaos of virgin ice-mountains and giant glaciers of the Muztagh-Karakoram. Lieutenant Younghusband descended into this valley, followed it to a point where a tributary entered it from the south, ascended this tributary, and forced his way over the very difficult ice-laden pass at its head.

Two years later, this same officer, now a captain, returned to the Aghil pass. Again he entered the Shaksgam valley. But on this occasion he explored it more thoroughly and followed its course up stream. He discovered the great Gasherbrum and Urdok glaciers, draining from the Muztagh-Karakoram range, and followed the second of these, in vile weather, almost to the col at its head. Falling avalanches forced him back, and he returned to the main valley convinced that there was no modern route across the head of this Urdok glacier into Nubra.

Captain Younghusband then explored down the Shaksgam, ascending and exploring several of its large side branches and finally made his way to its junction with the Yarkand river, by which he reached Central Asia.*

After the establishment of the Gilgit Agency, an officer stationed there, Lieutenant G. K. Cockerill (now General Sir George Cockerill, C.B., M.P.) carried out hasty route reconnaissances from the Hunza side and completed some valuable rapid surveys which he connected to those of Captain Younghusband.

In the same year, 1892, Sir Martin Conway led a party from England to Hunza, and mapped the trunks of the three great glaciers lying in the trough south of the Karakoram range, the

* A full account of both journeys was published in *The Heart of a Continent*. See also *Proceedings of the Royal Geographical Society* Vol. IV. P. 209, sqq.

Hispar, the Biafo and the Baltoro.* Of these three glaciers, the Hispar with its tributaries has since been re-surveyed by the Workmans in 1908; it was not however till 1925, as a result of the Visser Expedition,† that the work of these explorers could be correctly co-ordinated with the Shimshal region to the north.

The Biafo glacier has not been re-surveyed since Sir Martin Conway's expedition, but the map here, except of that great snow lake discovered by Godwin Austen at its head in 1861 about which there is some doubt, is good. The Punmah glacier which was ascended to the "New (or west) Muztāgh pass" by Godwin Austen in 1861 has never been re-surveyed, and the present map must be looked upon as approximate.

East of the Punmah glacier lies the great Baltoro glacier. Since 1892 several parties have visited it. In 1902,‡ A.C. Ferber reached the summit of the "Old (or east) Muztāgh Pass" but did not cross it. In 1903, the Eckenstein-Pfannl-Guillarmod expedition made an unsuccessful attempt to climb K², and sketched the Godwin Austen glacier, one of the head tributaries of the Baltoro. And in 1909 the Duke of the Abruzzi led his expedition to K² and mapped the higher section of the trunk and its feeders in considerable detail.

South and south-east of the Baltoro basin, the earlier reconnaissance maps of Godwin Austen have been greatly improved by Dr. T. G. Longstaff (1909) and by the Workmans (1911-12). These expeditions resulted in the sketching of the Hushe and Kondus glaciers and the mapping of the Siachen. It was in 1909 that Dr. Longstaff, with Dr. Arthur Neve and Lieutenant Slingsby, discovered the great length of the Siachen glacier and at last placed the alignment of the Muztāgh-Karakoram in its correct position, many miles further north than was previously supposed.

This journey of Dr. Longstaff and that of the Duke of the Abruzzi the same year revived the interest of geographers in the region north of the great range. For the Duke found that from a col, "Windy Gap", north-east of K², he did not look into the Shaksgam valley of Sir Francis; and Longstaff discovered unmistakable traces of travel on the upper Siachen glacier.

Three years later, the Workmans followed Longstaff's tracks, and thoroughly mapped the Siachen glacier. Far up it, at a spot named by them Spur Camp, they discovered the remains of ancient cairns, such as might have been made by natives crossing the pass at its head, or attempting to do so. But from the cols they reached

* Sir Martin Conway's expedition was described in his book "*Climbing in the Himalayas*".

† *Among the Karakoram Glaciers*. Jenny Visser-Hooft.

‡ *Geographical Journal*, Vol. xxx.

on the watershed, they also obtained no view of the mysterious valley to the north.

In 1913, Sir Filippo De Filippi led a scientific expedition to the Karakoram, and the following year completed the survey of the Rimo glacier, the main source of the Shyok river. In his programme was included the survey of the Shaksgam, but he was prevented from carrying out his object by the flooded Raskam river. Major H. Wood, R.E., of the Survey of India, who was with him, completed the survey of Hayward's source of the Yarkand river and in doing so discovered a pass near its head which he believed might give access to the Shaksgam.

On the north of the Raskam-Yarkand river, a great part of the K'un-lun range has been explored by Captain H. H. P. Deasy in 1898-99 and by Sir Aurel Stein on his various expeditions, and surveyed by men attached to them by the Survey of India.

Throughout all these journeys, support has invariably been forthcoming from the Government of India, from the Royal Geographical Society and from various scientific bodies in Europe. The 1861 surveys were entirely promoted by the Government of India. Sir Francis Younghusband was despatched in 1889 by the same government at the request of the settlements near Shahidula. Sir Martin Conway had the support of the Royal Geographical Society, as did his successors. The Duke of the Abruzzi and Sir Filippo De Filippi were supported by H. M. the King of Italy and the Italian Geographical Society, while India contributed a survey detachment under Major Wood, in addition to a grant of £1000 to the latter. Sir Aurel Stein's expeditions were financed mainly by India and surveyors were attached to him by the Surveyor General; and the last explorers in the field, the Vissers, were assisted by H. M. the Queen of the Netherlands, the Dutch Geographical Society, and by the Survey of India.

It will be seen from the above brief sketch that the upper Shaksgam valley, its upper tributaries and the Aghil ranges comprised the last piece of absolutely unknown country on this frontier. Nor had any white man, with the exception of Sir Francis Younghusband, ever been into the middle Shaksgam.

Since 1918, both De Filippi and Wood made preparations to complete the exploration of this last gap, but for one reason or another, mostly political and financial, their preparations had to be abandoned. De Filippi had already "resigned his rights" to Wood, when the latter, in December 1923, passed on to me his plans and blessing.

On the 21st November 1925, almost two years after I began to make my preparations, I received the following telegram:—

"Shaksgam exploration scheme sanctioned without any curtailment of your proposals".

In those two years I received an immense amount of help and

encouragement, particularly from the present Surveyor General, Colonel-Commandant E. A. Tandy, and from Sir Muhammad Habibullah and Mr. R. Ewbank of the Government of India, from De Filippi and Colonel Wood, from General Sir Alexander Cobbe and Mr. Monteath of the India Office, and from the Council of the Royal Geographical Society and its Secretary, Mr. Hinks. Also, as was to be expected, Sir Francis Younghusband took a great interest in my plans.

I proposed to cross the pass discovered by Wood in 1914, to enter the valley "H" beyond, and to explore it and the sources and course of the Shaksgam; the northern glaciers of the Karakoram range; and the Aghil range and mountains north of the Shaksgam. My object was to fill in by accurate survey as much as possible of the unknown gap between the surveys of the Duke of the Abruzzi, De Filippi, Wood, Longstaff, and Grant Peterkin (Workman Expedition), and to place the exploration map of Sir Francis Younghusband in its correct position in longitude. Incidentally I hoped to explore for traces of any human occupation or passage, ancient or modern, and to make various natural history collections, meteorological observations, and so on.

My proposals went into more detail than this, and included a timetable. I asked for one British Officer, a doctor, and Khan Sahib Afraz Gul Khan, of the Survey of India, to assist with the topography.

All these plans were sanctioned; and in the narrative that follows I shall show how we came from the east; how we explored down the valley, which we have proved to be the one up which Sir Francis looked; how we were held up and forced over the Aghil mountains to the north, and how we were prevented from regaining the Shaksgam lower down. The head basin of the Shaksgam, its sources and upper tributaries, and its first two big feeder glaciers have now been discovered, explored and surveyed. Stereo-photographs of the valley beyond have been taken and a map worked up from them in the Wild Autograph, adding detail and accuracy to the plane-table map; most of the Aghil ranges have been reconnoitred and surveyed, and a very considerable tributary to the Shaksgam river has been discovered. But there is still one small gap about 6 miles wide between the surveyed ridges, within which the middle Shaksgam must be, and Sir Francis remains the only European who has been here, though the position of his route is now very closely determined in longitude as well as in latitude.

The officers detailed for my party were Major R. W. G. Hingston, M.C., of the Indian Medical Service, and Captain F. O. Cave, M.C., of the Rifle Brigade. Hingston had been with me during my survey connection with Russia on the Pamirs in 1913, and had done excellent work on the last Everest expedition.

Cave had been recommended to me and I never had a doubt

that, though inexperienced, he would be invaluable on the expedition, for he was full of energy and enthusiasm. The Army Department asked me to take a third officer, Major H. D. Minchinton, M.C., of the 1st Gurkhas; and though another officer meant extra food and arrangements, it seemed well worth my while to take him. Minchinton had climbed in the Alps since his boyhood, and had some experience in the mountains of New Zealand and the Himālaya. Both he and I were members of the Alpine Club, but he was a far better climber than I, my knowledge being that of an amateur, picked up in six seasons survey in the Himālaya.

The Khan Sahib was in every way experienced for his duties. He had started his career as a soldier and learnt surveying with Sir Aurel Stein on one of his arduous expeditions in Central Asia. During the war he had done some excellent exploration in North Persia; and since then, as recently as 1925, he had added to his laurels by surveying the country explored by the Vissers in Eastern Hunza. I knew him personally to be capable and tireless, with exactly the right temperament for overcoming difficulties.

With the exception of Hingston, who retired from the party at the last minute owing to illness, and who was replaced by Major R. C. Clifford, D.S.O., M.C., of the same Corps, these officers comprised my party.

Long before sanction was granted, and before these officers were appointed, plans and organisation were thought out. The authorities in Kashmīr insist that travellers must make their own arrangements with coolies if they cross the Zoji La, the first of the passes, before the 15th May; and as the Khardūng pass, north of Leh, lies deep in snow early in the year, and is not normally open to the caravans till the end of June, our dates were ruled by this official opening of the Zoji.

Purchase of supplies and fodder in Ladākh for a large party is always dependent to some extent on the season and the crop; and enquiries had to be made about obtaining provisions in Srinagar, Ladākh and Baltistān. Ponies and yaks, the baggage beasts of the trade-route, are not normally fit for strenuous work early in the year, being underfed in winter.

Early in 1926 we began to make our advance arrangements in Ladākh, by forwarding money, engaging a caravanbashi and buying ponies and supplies.

There were a hundred and one different matters to be thought out and arranged for both in India and in England. Mr. Hinks, the Secretary of the Royal Geographical Society, very kindly undertook to arrange for the purchase of all our European provisions from the Army and Navy Stores in London. I had made out lists of our requirements, dividing these so that they could be packed into boxes, each suitable to last four officers for five days, and weighing not more than 56 lbs. each. An arrangement such as this

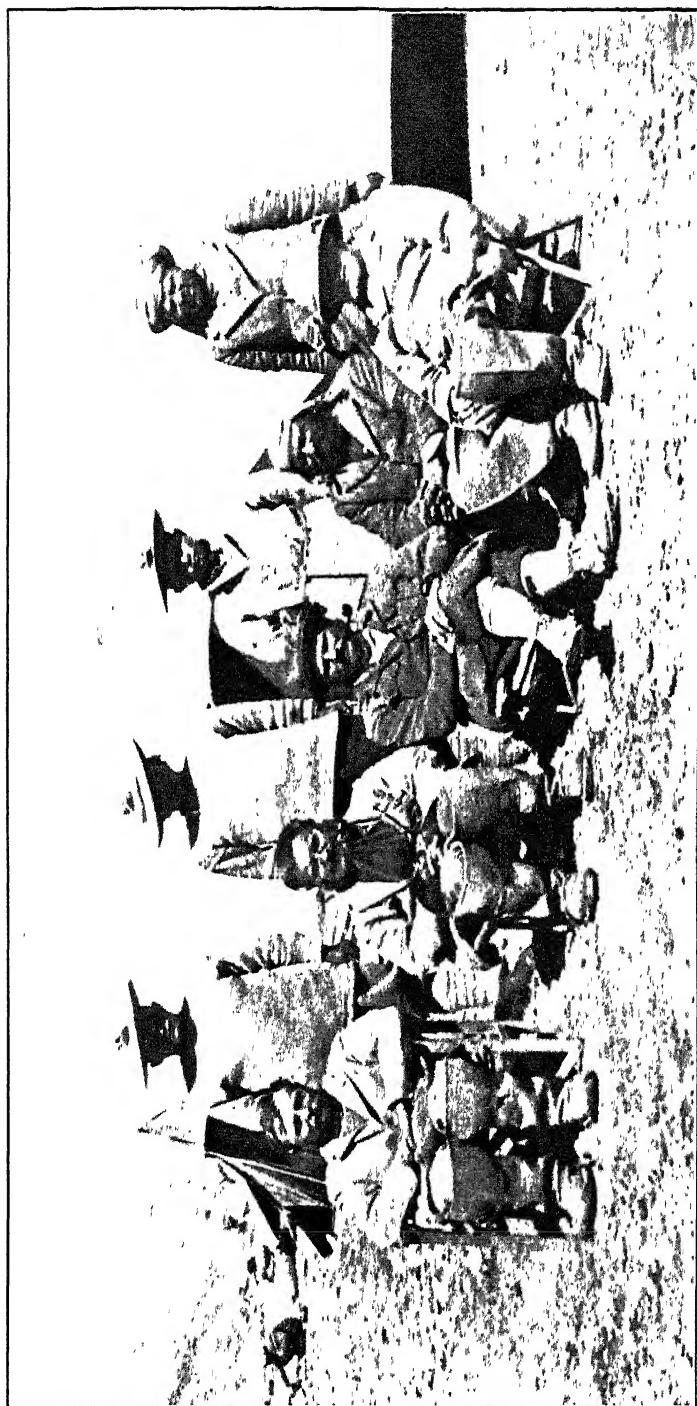
is essential on such an expedition. We could count on no supplies of any description for at least three months, and had therefore to calculate everything, including flour and meat.

The Council of the Royal Geographical Society also, after exhaustive enquiries, purchased for my use the newly designed Wild Photo-theodolite, in order that I might make experiments in stereographic survey; and Mr. Hinks kindly bought on behalf of the Survey of India the necessary accessories for its use.

These things reached India towards the end of March, the instruments being sent up to me at Simla, so that I could practise with them before starting, the provisions and alpine equipment, which were also bought in England, being sent direct to Rāwal Pindi.

On Wednesday, 14th April, all our preliminary arrangements were completed, and on this day, according to the programme made out a year before, I left Simla for Pindi, picking up Minchinton and three Gurkhas of his regiment at Lahore.

Two days later we all assembled at Rāwal Pindi; the Khan Sahib, who had gone ahead to draw equipment from the survey party stationed there; Clifford, the surgical specialist from Lucknow; and Cave from Peshāwar.



GROUP IN THE YARKAND VALLEY
FRONT ROW, LEFT TO RIGHT: CAPT. F. O. CAVE, M.C., MAJOR H. D. MINCHINTON, M.C.,
MAJOR K. MASON, M.C., R.E., KHAN SAHIB AFRAZ GUL KHAN, C.H.,
MAJOR R. C. CLIFFORD, D.S.O., M.C.

CHAPTER I

RAWAL PINDI TO THE SHAKSGAM

AT RAWAL PINDI we were joined by a Pathan havildar of the Survey of India, Lal Mir, who had been with me in Kashmir before the War. We also collected warm clothing, which I had previously ordered, and the provisions and equipment which had arrived from England. We reached Srinagar on the 18th April, in typical April weather, just before the road broke behind us and held up the motor traffic for several days.

The winter of 1925-26 had, up to March, been abnormally mild, with clear crisp days throughout the outer Himālaya. We had looked forward to an easy journey into Ladākh and beyond. But early in the spring, a succession of depressions arrived from Persia, and these brought heavy snow to the Western Himālaya, blocking all the passes. The outlook appeared anything but hopeful by the beginning of May.

The selection of porters in the Himālaya for difficult exploration is a matter which needs the utmost care. I can lay claim to have been most fortunate, for I have never, in all my various seasons of travel, been disappointed with the men chosen. To get the best out of them, they must be treated with consideration and tact. It is not sound policy to employ men from large centres where they have come into contact with easy-going globe-trotters. Such men have generally lost their hardihood. Again, it is a bad plan to employ porters too near their homes. To take men from the last inhabited village bordering on unknown country is folly. Such men have an exaggerated idea, fostered by legend, of the difficulties ahead, and nervousness is born before the start. It is better by far to bring unsophisticated men in from outside, and gain their confidence in a fat country. They must be well fed and well cared for, but not spoilt, and they require almost superhuman patience, as children do. They must be promised fair wages and full stomachs, fairer and fuller than they get at home; such promises must be kept and each man must have food that he likes.

The more porters required, and the more distant and desolate the country to be explored, the more these principles must be observed. If anyone goes short of supplies, it must not be the carriers.

On them falls the brunt of the hard physical work; and with them fundamentally lies success.

Our permanent transport consisted of 24 permanent porters and 18 ponies. The use of the latter was decided on after consulting previous explorers of neighbouring regions, and was considered with the information thus available as the most economical and efficient arrangement.

The twenty-four permanent porters were being engaged from among the Ladakhis of the Indus valley some distance below Leh. They were intelligent children, loyal, hardy and stouthearted. Their ration was a pound of barley *satu*, a pound of wheat *ata*, with some tea, butter, salt, sugar and tobacco, and the promise of fresh meat when possible. The Gurkhas' ration was based on the service allowance, and included rice and *dall*. The bought ponies were to get four pounds of *grim* (barley) a day, which also was more than the normal fodder ration on the trade-route.

The tea came from Dehra Dūn, in India; the rice and *ata* from Kashmir and Ladākh, the barley from Leh and the Nubra, the salt from Tibet, and the tobacco from Skardu.

Our own supplies had been most carefully thought out, and were now handed over to Cave. We were most fortunate in engaging two excellent Kashmiri cooks, the best of their kind I have ever met. The older man, Aziza Rathar, had had a lot of experience on expeditions, amongst which he included the Vissers' of the previous year. The younger, tall Habib Lun, had been almost everywhere in Kashmir territory.

One day of fine weather during our stay in Srinagar enabled us to try the new photo-theodolite at Gulmarg, the summer hill-station of Kashmir, now under several feet of new snow. But the wait at Srinagar was of value for many reasons, not the least being the chance it gave us of fitting ourselves physically for the mountains; and each morning, wet or fine, we treated ourselves to a run up and down the Takht, the hill of exercise overlooking Srinagar.

Simla kept us informed about the weather we were to expect, and on the 9th, the daily telegram ran:—

“Western disturbance clearing away. Expect weather begin to clear after today.”

That afternoon the heavens, as if in derision, emptied bucketfuls of rain. But we moved off on the morrow, pinning our faith to the prophets.

It was dull and rainy as we passed down the Jhelum river through the drab town, but the 11th fulfilled our hopes. We pushed on the next day from Gandarbal with pony transport, 51 baggage animals in all, which brought us on the 13th to Gund, where they were paid off. On the 14th, with 159 porters, we passed the Gagangiyer gorge, and the next morning made a short march to the rest-house at Bāltal, at the foot of the pass, reaching it by midday.

There we laid out the loads in two long lines, and told off each coolie to his pack.

It is an extraordinary thing, that these men, who are accustomed year after year to cross this pass, never learn to treat it with its due respect. On a cloudless night in spring, after two fine days, it offers an absolutely safe clear passage. Under any other conditions of time or weather, it is dangerous at this time of year. But there are still some people in the world, who regard an avalanche as an act of God, who follows no rules.

Two small avalanches broke away from the summits near the entrance to the pass, one at 8 o'clock and the other at 9.45. They did not reach the valley bottom. The whole party moved forward at 11.15, Minchinton and myself in the van, the Khan Sahib in the middle, Cave and Clifford at the tail of the long line of coolies. It was a cloudless, but pitch black night, for the new moon had set. Our way was lit by candle lanterns.

The way led over dead avalanches, which, fallen from the rocky cliffs towering into the blackness above, blocked the bottom of the gorge to a height of some two hundred feet. There was no difficulty, though the party strung out. We reached the end of the steep slopes at 3 a.m. and the summit of the pass three-quarters of an hour later. The head of the caravan passed the Mechoi bungalow at 5.45 and went on, the rest of us stupidly halting for breakfast. The last six miles of soft wet snow this day afforded us a lesson in early travel.

Clifford held a medical examination in the afternoon at Matayan. Twelve men suffered from inflamed eyes, in spite of their dark glasses; two had cut feet; one had a slight fever, from which he speedily recovered. There were no cases of frostbite. Two days afterwards a small party of natives tried to cross the pass by daylight, were swept away by an avalanche and killed.

There is nothing to record of the journey to Leh. For there is little difference in this part of the Treaty Road throughout the year. We kept to our programme, except for a day's halt at Dras, and reached Leh without incident on the 27th May.

At Nimu, the last stage before Leh, we found Ahmad Akhun, our caravanbashi, awaiting us; a plausible man who gave us the impression that all our troubles were at an end, and who, to make a good impression, had spread a sumptuous meal for us at the end of a hot, dusty ride.

On the last march into Leh, we passed the village of Phyang, and picked up Kunchuk; a man who had been well recommended to us in Srinagar by Major Oliver, whose shikari he had been during his Joint Commissionership. Kunchuk's official duty was to look after the Buddhist porters, and he did it well. But he had also the keenest eyes for game and a stalk that I have ever known.

At Leh Minchinton checked every detail of my calculations for

food and fodder, and sealed up the bags ; Cave surveyed our own provisions, and Clifford held an inspection of the porters and ponies. We also reviewed the financial situation, and bought three more animals, making twenty-one in all, for the Wazir gave us permission to draw fodder for them all from the State granary at Pānāmik.

There are three main passes over the range north of Leh, more or less in use at different times of the year. The Chang La, which was improved for use with the summer route constructed by Major Oliver up the upper Shyok, has now fallen into disrepair and general disuse. The Digar La, by which most of the winter traffic travels, is only fit for men on foot. The summer route crosses by the Khardūng La, over which passes a rough track fit for animals. This last also is the most direct to the Nubra valley, which was our destination owing to the advantage that Pānāmik gave as a base for our explorations.

In the open caravan season, there is no difficulty in crossing the Khardūng La ; travellers are therefore liable to underrate it in the spring, when, owing to the cup-shaped curve of the crest, snow accumulates in deep drifts, which only clear late in the year. Ponies are rarely, if ever, taken over laden, and special arrangements have to be made for yaks between the two high camping grounds, or *Polus*, on either side of the pass.

Wood had warned us that Leh would be the crux of our transport troubles ; and he was correct. When we asked for baggage yaks, all manner of objections were raised, and we eventually were forced to acquiesce in the suggestion of the local official. Our baggage was to be divided into two parts. Seventy ponies were to carry to the Leh Polu, on the near side of the pass, on the 6th, where they would be met by seventy yaks, which would tackle the pass in the early morning of the 7th, preceded by thirty unladen yaks to trample a way. The yaks, weak after the winter's shortage of food, would halt for a day on the far side to graze, return on the 9th or 10th, and, after another halt, would carry the second lot of baggage over on the 12th.

We now completed our arrangements. Our twenty-four permanent porters left nothing to be desired. They were cheery, hardy and grubby : twenty-one of them were Bhuddists, three were Muhammadans. The Bhuddists shared only a few names between them ; there were seven Tashis, four Tundufs, five Punchuks, three Sanams, three Sewangs, and two Sirings, variously permuted. They had to be slightly re-christened for convenience.

The twenty-one ponies varied in price between sixty-two rupees and a hundred and fifty-six, the price I think varying in direct proportion with the nearness of relationship of the seller to our caravanbashi. At this time of the year it was by no means easy to get twenty-one fit ponies, and still less easy to make bargains. The seven pony-men, all Muhammadans, were from Leh or the

neighbourhood, and most of them had done one or two journeys to Yarkand.*

Minchinton and Clifford started off with the first party on the sixth of June. The day became overcast and cloudy, and the snow remained soft throughout the night. The caravan left the Polu at half-past four the following morning, but after progressing only a quarter of a mile, it stuck in the soft snow. Every effort to move forward was vain. Thereupon the yak-men unloaded their beasts, piled the baggage and dispersed to their homes, declaring that the pass would be impracticable for at least twenty days.

I determined however to make another effort to open the pass. I felt convinced that this failure was due to two reasons: clouds had prevented the freezing of a hard surface, and the start had not been early enough.

On the 9th June we collected thirty more animals and Minchinton and I moved up to the Polu with our permanent porters. Major M. L. A. Gompertz of the Baluch Regiment, who had arrived in Leh the previous day from Srinagar accompanied us.

The next morning we rose at 2.15, and roused the camp. About half-past eight, we arrived at the summit with nine unladen yaks and eighteen lightly laden porters, the remaining animals having given up the attempt. After stamping down the drift snow at the pass, we started back again about ten o'clock driving the yaks in front. Fortunately by now the snow had become very soft, and we were able to clear a broad track three feet deep. The pass was open.

Minchinton now remained at the Polu with the porters, and Cave joined him from Leh, while the rest of us completed the final arrangements for the crossing and the journey beyond.

On the evening of the 12th we were reassembled at the Polu with over a hundred yaks and a hundred coolies, beside our permanent transport. At two o'clock the next morning the camp was astir and the ponies moved off under Ahmad Akhun. Shortly afterwards the yaks were loaded at the dump.

As dawn broke the caravan reached the first long snow traverse, where we found that the ponies had missed their way and, instead of being ahead, were cutting into the line of yaks. Some delay ensued, and it was not till a little before seven o'clock, that the first of us reached the summit. Most of the animals were still floundering in the snow, some six hundred feet below. The porters were however arriving, and these after depositing their loads were sent back to assist.

Some fifty feet below the crest there was an eight-foot drift of soft snow. At one time there were three yaks and two ponies buried to their necks in this. It was only by taking tents from

* For transport details see Appendix III.

their bags, laying a canvas track on the snow, pulling, pushing and lifting the beasts with tentpoles under their bellies, that we eventually dragged them to the summit.

This small canvas track solved our difficulties. By half-past eleven, eight hours after the start, we had eleven unladen ponies, about eighty yaks, and the greater part of the baggage on the pass. Several animals were bleeding at the mouth, and all, men and animals, were dead beat. Some twenty yaks were lying about on the slopes, some by the side of the track, like shipwrecked hulks, while others had somersaulted off the road some distance below. And littered here and there, were bags of flour, cases of provisions, and the remainder of the baggage.

Owing to the late hour, the snow on the north side, which we had not ploughed, was no longer fit for animals. We therefore decided to take down only a light camp to Khardüng Polu, and to leave the greater part of the baggage on the summit. The yaks were however driven down on the Leh side, where they again improved the road.

That night we spent uncomfortably at the Khardüng Polu, and the next morning Gompertz returned to Leh. He afterwards sent me word that two yaks had been killed through slipping from the steep slopes, and later, I paid compensation for these and for two others, which succumbed to the hardships of the day. But though we regretted these casualties, they could in no way be avoided, though I believe that if the caravanbashi had not lost his way in the morning and so disturbed the whole line of march with the ponies, the yaks would have reached the summit earlier in the day before the snow was soft.

By the 16th, we were complete with all our baggage at the village of Khardüng, and on this day, having changed our transport to more than a hundred ponies, we marched to the Shyok and followed this river down to the village of Kharchar. The Shyok river at this time of year flows in a number of channels, in a flood-bed a mile wide and is fordable at several places. The scenery is on a large scale, though somewhat monotonous, being relieved only near the river bed by occasional villages and bush jungle.

We entered the Nubra valley on the seventeenth, after crossing the Shyok by a good wooden suspension bridge near Thirit. The valley is one of the most interesting in Ladakh to the geographer, for at its head lies the Siachen glacier, the longest outside sub-Polar regions. The whole valley at one time must have been filled by a huge glacier, nearly a hundred miles long, which pushed its snout across the valley of the Shyok, damming back that great river, and causing an immense lake to form behind it. Longstaff, who in 1909 passed up the Nubra by the right bank, remarks that the solid rock near the junction is for hundreds of feet above the river level polished, rounded, and scratched by the ancient glacier. To my



HAULING BAGGAGE ANIMALS UP THE LAST FIFTY FEET
OF THE KHARDUNG PASS.

mind there is no doubt about the existence of this glacier, for we could still observe the remains of old lateral moraines, first noted by Drew, high up the mountain sides, though they have been much eroded since his day.

Further evidence is the comparative youth of the gorges, through which drain the *névé*-fields high up near the Saser watershed to the east of the Nubra. The glaciers here are comparable to the side glaciers of the Siachen today. They were first left hanging above the Nubra valley, when the trunk glacier retreated, and shot seracs and rocks to the valley floor. Since then they also have retreated, and their waters, laden with moraine, have carved the narrow marginal gorges that now exist. This operation is still in progress.

On the eighteenth of June we reached Pānāmik, "the Eye of the Country", the last inhabited village on the trade-route, and our advanced base for our forthcoming explorations.

From the experience of the De Filippi expedition, I was justified in expecting a very fair amount of grazing in the Yārkand and Shaksgam river basins, and burtsa fuel almost certainly below 16,000 feet; and, since Sir Francis Younghusband had found his ponies in the middle Shaksgam of great value for fording the rivers, I had decided to employ both ponies and coolies for the actual exploration.

We had planned to be away from Pānāmik from the 20th June until the first week of October, and the nearest point of the Shaksgam, as far as we could estimate, was fourteen days march, mostly through excessively barren country at an elevation of over 16,000 feet. Including the fodder required for our own ponies for the whole period, I calculated that we had 158 pony loads and 24 loads for our porters. We therefore required 137 more ponies (and 46 pony-men) to carry loads for these fourteen days, and they had to be fed for twenty-eight. This food also had to be carried by more animals, which also had to be fed; and so on. We had however one point in our favour. We were able to calculate the daily consumption of supplies and fodder and therefore the number of ponies at the end of each day's march, which could be sent back to the base.

All these calculations had been made out by me some months before and a rough estimate of animals sent ahead to Pānāmik. It only remained now to check the figures finally, and fix up the contracts. We arranged a rate of thirty-seven rupees per pony for the month's journey to the Shaksgam and back, the risk of loss to be on the owners. We ourselves purchased all the fodder, Minchinton being in charge of the daily issue to the pony-men on payment. These were better terms than those that rule for normal caravan traffic, though less generous than have been paid on occasions by other travellers. They were not agreed to without a good deal of bargaining; but once they were settled, the men expressed

their satisfaction and rapidly completed their preparations.

At Pānāmik we also fixed up our postal arrangements, enlisting four men who were experienced forders. Two were to carry our post-bags from Pānāmik to the foot of the Karakoram pass in seven days, while the other two were to carry between this spot and the Shaksgam. We hoped thus to maintain a post about once a fortnight.

On the 21st June we left behind the habitations of the Nubra and started for the wilderness. We numbered altogether about a hundred men and two hundred animals. For eight miles the track keeps along the left bank of the river as far as the junction of the Thulanbuti Chu. The old road used to follow the main valley further to Changlung, where a difficult "staircase" ascent led over a spur to Umlung. But since the upper Shyok route, which had been constructed in its place by Oliver, was discarded just before the War, the whole Nubra alignment has been much improved, and a good road cut into the face of the cliff close to the Thulanbuti tributary. The ascent of this granite slab, some 1,200 feet, is by thirty-five zig-zags, and is exhausting for laden animals, though not in any way dangerous or difficult for beasts with sense. Unfortunately, the baggage ponies of the trade-route are more than usually stupid, and we nearly had a nasty accident. At one of the hairpin turns one of the hired animals swung back on to the following pony, which took fright, charged the first and pushed him over. The first one fell, cast his load and both hind legs over the edge of the built-up parapet, sending down a shower of rocks to the line of animals in the section of road below. For a moment, it seemed that both the pony and its load would be amongst us. Fortunately, the men were equal to the emergency. Road space was instantly cleared, four men seized the animal which had fallen, cut the load clear, and with the help of others, heaved him back to the road.

Umlung, where we passed the night, is a small camping ground above the Thulanbuti gorge. There is practically no grass, and fuel takes some time to collect. We were none too cheerful, being worried about the ponies, some of which were down with colic.

The next morning broke fine and we marched to Skyangpo-chhe. The march is uninteresting over great moraines, which have been cut through by the Thulanbuti. Minchinton went ahead in the hope of shikar, and shot a burrhel, the wild sheep of these parts. This helped to keep up the spirits of the men on arrival in camp, for the weather had again turned against us, snow was falling, and there were several more animals down with colic. One of our own twenty-one ponies died from this cause before reaching camp.

Clifford came to the conclusion that there was black vetch in the barley, and we set the men to picking out the small seeds. Whether or not this was the true cause of our trouble, I do not know; our caravanshahi laughed at the idea. At any rate, there

were no more cases of colic throughout the expedition.

The following morning when we woke up, the ground was white under a cloudless sky. On the advice of the men, we decided to leave the ponies at Skyangpo-chhe, and go on ourselves with the ponymen, porters, and ten unladen yaks, to open the Saser pass.

This pass is much dreaded by all who use the trade-route, particularly early in the year and after bad weather. As with the Khardung La, no one had yet crossed it this year, and no one was able to tell us its condition. But in other respects it differed fundamentally from the Khardung; and though I should say that in bad weather it is worse than the latter, I cannot believe that normally its drifts would cause much trouble.

It is a curious pass, and except that we afterwards met with others with the same characteristics, I should have classed it unique. The highest point lies on the body of a glacier, stretching from the southern side of the depression in the Saser range right across the watershed, forming, as it were, an immense glacier saddle. On each side snouts project and drain into the valleys, forming the saddleflaps. West of this, and draining into the Thulanbuti river are four more glaciers, two draining from the northern slopes and two from the south, each of them almost, but not quite, blocking the valley. On the near side of these, the valley opened out and had a level bottom, at present covered by two feet of snow, which formed a soft crust by midday. The highest point of the pass is at an altitude of 17,600 feet above sea-level, but the open valley, Sartang, is only about 600 feet lower.

From Skyangpo-chhe to Sartang is about six miles of pretty rough going, and we took longer to cover this distance than we had anticipated. We therefore sent back a man at once to Clifford asking for a light camp for ourselves at Sartang.

The first part of the ascent from here lies over the moraine of the Angkar-shak glacier, which projects from the northern side of the valley and almost abuts the Sartang glacier opposite. We cleared a track over this moraine, and cast the boulders into the valley below. A traverse by the eastern side of the glacier caused a good deal of trouble, and a complete track had to be cut with axes into the ice.

We were just completing this section when suddenly the men raised a shout, and we saw descending the next glacier, the Bongrochan, a man leading a laden pony, and followed by two more men. On seeing us he signalled, and after reaching the foot of the glacier, halted. We found him to be a trader, as we had expected, but he was completely overcome by exhaustion and his men by snow-blindness. They had abandoned their caravan somewhere near the summit.

After a hurried consultation, Minchinton went on with as many men as possible to cut a track up to the abandoned animals, while I

stayed with the trader and revived him with aspirin and tea. We then transferred him and the load from his pony to a yak and brought him back to Sartang, his own animals arriving later in the afternoon.

At Sartang we found that the man, Torabaz Khan, was an Indian trader from Yarkand, originally from Punc. He told us that rumour had reached Yarkand from Leh that some British officers were bringing a caravan over the Saser pass about the middle of June, and that he had expected us to have opened the pass. After giving him a substantial meal, he passed on with his recovered animals down the Thulanbuti river.

Our tents did not reach Sartang from Skyangpo-chhe until seven o'clock, owing to the soft snow. We therefore sent word to Clifford and Cave to break up camp at midnight, in order to cross the level part of the valley before dawn.

The twenty-fifth was another strenuous day. After a good night the caravan was sighted by us at Sartang at 4.30. We rose at once, packed our shelter tents and led the animals over the terminal moraine of the Angkar-shak glacier. Beyond this point our difficulties began. The road that we had cut the previous day had frozen to a hard slide of ice, and every one of our two hundred animals had to be assisted over this part by hand. The Khan Sahib and I stayed here to direct operations while Minchinton and the others went forward to the next glacier.

Some of the beasts slipped and fell down the slope, but we had no serious accident, and I reached Minchinton behind the last animal about 10.30. Meanwhile he had been getting the ponies over the Bongro-chan, the "Place of the Dead Ass". Clifford and Cave had gone beyond to have some food and to prepare the ascent of the last glacier, the Saser.

By 11 o'clock Minchinton and I followed after the last pony to the gap between the Bongro-chan and Saser glaciers. We expected to see the caravan ascending the latter, but to our dismay, we found the whole of the animals halted, with their loads cast down on the snow! Clifford and Cave were ahead on the Saser glacier, but had been unable to persuade the men to keep on. The former sent me word that if we could only get the men to move at once, we could still cross, but that every moment the snow was becoming softer.

Every argument was useless. The hired ponymen absolutely refused to budge. We therefore loaded up some fifty animals with the most essential baggage, and started with these for the pass.

Our own men were splendid, especially Kunchuk and the porters. But our progress was very slow. If the caravan had gone straight on without a halt there could have been no difficulty; but the snow was soon in a dreadful state. The Gurkhas and porters carried the loads up by hand while the rest of us ploughed through the snow with unladen beasts.



PARTY CROSSING THE ANGKAR-SHAK GLACIER, THE FIRST OF THE SASER LA GLACIERS.

As we reached the summit, a snow-storm came on. It was not severe, but contained just the right amount of discomfort to break the strike of the disconsolate ponymen below. To our relief we saw them reload their animals and start in our tracks. The rest of the crossing was easy, and the head of our own caravan reached the camping ground at Saser Brangsa about six o'clock. During the night and early morning the remainder of the baggage was brought in.

Saser Brangsa was a perfect Golgotha. The half-ruined shelter hut was surrounded and littered with the skeletons of baggage beasts, the grim tax paid by the traders since this route was reopened. This camping ground is the furthest reached by the Central Asian camel, and here for the first time we met his bones. From now onwards until we left the caravan route at the foot of the Karakoram pass, we could not lose our way; for never were we out of sight of these signposts of death.

The whole caravan was exhausted after its exertions of the previous day in the soft snow. But we could not afford to halt. Before us lay many days of arid desolation, and at this time of year it was bound to be a race against time. Every day spent loitering by the way must diminish the fitness of our beasts, owing to the want of grass. We had to harden our hearts against a false sympathy. The spare yaks and weaker ponies were therefore left at Saser Brangsa with enough fodder to pick up strength for the return journey to Pānāmik, and the caravan moved forward on its way.

There are two variations of the trade-route to the Karakoram pass from Saser Brangsa. There is the natural route up the valley of the upper Shyok, past the snouts of the Ak-tāsh and Kumdan glaciers, to the grazing grounds of Yapchan, near the point where the great Rimo glacier drains into the Shyok. And there is the diversion over the Depsang Plains, which must be taken when the natural route is blocked by the advance of these Ak-tāsh and Kumdan glaciers.

We were told that the valley route had been just passable the previous year, but that towards the end of it the Ak-tāsh glacier had crossed the valley and blocked it. Torabaz Khan at Sartang had confirmed the report that the valley was now wholly blocked and that a lake was forming behind the glacier dam. We were therefore constrained to take the longer route, and the most desolate.

We forded the Shyok river opposite the Brangsa. There was only a foot of water in it, but we were advised to be careful of quicksands. The path now leads up the Chong-tāsh tributary, for which the Turki traders have a nickname meaning "the stream with eighty fords". It is enclosed by vertical shale cliffs, but was at this time of year largely covered by a snow bed. Presently the track climbed out of the tributary, which itself drains from the

south-western face of the Depsang peaks, and ascended the open Chong-tash plateau.

We were in a different country. The bold granite mountains and precipices, the deep valleys with frowning walls, the vast scale of height were all gone. An open plain enclosed by comparatively gentle slopes of limestone and shale lay before us. The aspect was more Tibetan and less Himalayan than we had been used to. In the middle of the Chong-tash plateau was a lake, by the side of which we halted for lunch and where we shot a Ruddy Sheldrake and a Gadwall. Then the track led us down gently to the camping ground of Murgo, where there was a scanty grazing for our tired animals.

The next day we marched up the "Burtsa river", so-called because *Burtsa*, the hard gnarled woody root, here used for fuel, is the only useful commodity in the valley. Even this is rare for long distances further up the valley. Grass is scarcer still, and only exists in one or two places.

We had intended to reach the point marked "Kizil Angur" on the map, but the state of the road and the condition of our animals would not admit of this. The march was however of great interest and full of surprises.

About seven miles from Murgo, beyond the gorges of the Burtsa river, we passed the first caravan from Khotan. The traders, like Torabaz Khan, had started for the Saser immediately the news had reached Khotan that we had started from Leh. There is apparently no competition among these people to open the passes.

At times the valley closed in to form a gorge; at others it opened out, and we had grand views of fine peaks clotted with ice-caps, or faced with great masses of weathered-red marble. Sometimes we scrambled to the valley bottom and forded the stream in its stony bed; at others the track wound up and over and round the broken spurs.

We camped at a spot about 15,000 feet above sea-level, after a march of some fourteen miles. Several animals had to be unloaded on the way and brought in slowly, while men went back for their loads. Only a very scanty grass was available, and some of the ponies had to be sent back to Panamik early the next morning, for there would be no more grass for four days.

The men were anxious to push on and cross the desolate Depsang plains while the weather held fine. The weaker animals were therefore lightly laden, several of the pony-men themselves relieving their animals of their burdens. We were able to complete a march of sixteen miles and to reach the spot where De Filippi had his standing camp on the Depsang plain. We camped by the stone engraved by him: "Campo Spedizione De Filippi. mcmxv".

The night of the 27th June brought a snowstorm. While the snow was still falling, we struck camp and sent it ahead, Minchinton

and Clifford taking the rifles to hunt for antelope.

The wind was bitterly cold, blowing from the Rimo glacier, but the going was easy and we made rapid progress. The whole country is open, entirely different both geologically and geographically from that on the other side of the Saser. But it is utterly desolate, and again there was no grass for the animals. We camped about five miles from the foot of the Karakoram pass.

The next morning we left the caravan route. The road, well-defined still by its litter of bones, bears to the north-east side of the valley and climbs by an easy gradient over the enclosing slope. Our own way led over the natural watershed, at the head of the main valley. The divide is hardly perceptible, for small tributary streams trickle among the disintegrating rocks, flow in all directions, and finally, as if uncertain whether to take the road to India or Yarkand, separate on the pass and flow both ways. Such is the Indo-Asian watershed.

The pass, called afterwards by our men, the Kadpa-ngonpo La, "the Blue Rift Pass", from a bluish scar on the hillside, led us to the valley "A" of Wood. Its altitude is about 17,300 feet. Some five miles beyond the watershed, "Stream A", named by us the Lungpa Ngonpo, becomes more enclosed by occasional small defiles of bare but rapidly crumbling shale and limestone, among which I picked up an ammonite.

After a march of about sixteen miles we reached Wood's Amphitheatre; and after a rapid reconnaissance found grass. This Amphitheatre, discovered by Hayward in 1868, has been surveyed and described by Wood in his Report.

Wood reached this spot on 7th July 1914, i.e. a week later in the season than we. On examining his photograph taken about the time of his arrival, the condition of the surrounding mountains appeared to be much the same then as it was now. This fact meant that the late snowfalls of the Himalaya probably had not affected the country beyond the Muztagh-Karakoram range, and that there would not be an excess of snow to melt and swell the rivers. Nor, we hoped, would the grass be late in coming up.

On the 30th June we halted for a day to allow the animals to graze and recover from their long fast. Cave had shot an antelope the previous evening, so we decided to search for more in order to raise the spirits of the camp by means of fresh meat. We only had two rifles between the four of us. Minchinton and I therefore set out for the morning stalk; and Cave and Clifford took the afternoon. Between us we shot five animals, much to the delight of everyone.

The first of July turned dismally wet; snow squalls and a biting wind cut into our faces as we marched up the valley "B" of Wood, towards the Rimo source of the Yarkand river. Two of the hired ponies, unable to recover from the effects of their recent

hardships, were left to graze in the Amphitheatre, and to be picked up a few days later by the caravan on its return from the Shaksgam. A third was too far gone to be taken along or left behind and was killed ; and two more died by the wayside on this day.

We camped for the night a short way up Wood's valley "F", the highest tributary on the left bank of stream "B". Tents were pitched during a blizzard, which drove the mercurial spirits of our men down to zero again. About dinner time we heard them murmuring.

It struck me then that they were like little children afraid of the dark. Their murmurs were not those of the children of Israel in the wilderness, for our Promised Land contained no milk or honey. They were not disloyal. It was simply that for the moment their reservoir of faith was low. Like children they wanted to be comforted, to be reassured by kindness.

So we sent for them and calmed away their fears, praising them for what they had already done. Minchinton, remembering Saul, turned David with a gramophone ; and laughter was heard again in the camp. On the following morning, July the second, we reached our goal and stood on the edge of the unknown.

GASHIERBRUM I
26,470

21,265 21,758 21,655



LOOKING DOWN THE UPPER SHAKSGAM FROM ABOVE THE DEPOT.
LUNGPA MARPO OPENING ON RIGHT.

CHAPTER II

THE UPPER SHAKSGAM AND THE KYAGAR GLACIER

PASS "G" was discovered by Wood in 1914, and according to him it led to an open valley, "H", which might be the head of the Shaksgam. Anywhere else on earth it would be considered a curious pass; but we had already met one example of its kind, the Saser, and before the end of the expedition we came to look on its type as normal for this region.

It is formed at the watershed between the valleys "F" and "H", the ascent and descent on either side being gentle and easy over disintegrated limestone. A considerable glacier, belonging to the Rimo system, stretches downwards towards the pass, and rests on the latter, like the saddle on a horse's back. The cantle stretches upwards to the south, the saddle-bow ends abruptly with a wall of ice, athwart the watershed, without blocking the passage, and the saddle-flaps fall into the valleys on either side.

Wood wrote of the valley beyond: "The valley was fairly open but of no great width, and was bounded on both sides by high hills, only snow-covered on their summits, and no glacier of any sort could be seen to enter it".

We found it to be bounded on the north by rounded disintegrating hills, off which the snow had only recently melted, causing the lower slopes of the hillsides to be slightly boggy. From the pass itself it was impossible to guess what happened to the valley lower down, and as we pitched our tents only two miles beyond, we went to bed in ignorance.

On the third of July we continued down the valley, surveying as we went. Three miles from camp, the river entered a gorge, at the entrance to which we found the caravan halted. This gorge was about a mile long, with walls from thirty to fifty feet high. In places it was only just wide enough for the passage of laden animals; there was little water in the river, though it was augmented later in the day by the melting of small hanging glaciers, of the "clotted cream" variety, perched between lofty mountains on the south of the valley.

Above the gorge walls were long slopes of limestone debris, split and torn from the disintegrating hills by frost. Beyond, the

valley opened out, but even here the animals had to leave the stream bed in several places. Towards one o'clock the river began to rise and the water became thick with mud, though it remained easily fordable, even after the junction of a considerable glacier stream entering from the south. We also passed several small glaciers hanging to the northern summits of the watershed to our south; all these seemed to be retreating, and showed terminal moraine banks on the higher slopes.

Above the gorge new grass had begun to sprout. Below was complete desolation; not a blade of grass, not one root of the precious burtsa, which we so sorely needed.

After about twelve miles the animals began to fail, and two miles further we were obliged to halt the caravan in a spot still destitute of grass or burtsa. The altitude of this camping ground, which afterwards became our depot, was 16,800 feet. Straight opposite us down the valley rose a steep mountain wall apparently of a reddish limestone, crowned by ice-capped peaks and glaciers.

Having pitched camp, we explored ahead. Only three-quarters of a mile from camp the river entered another small gorge; and, climbing over this to the west, we found ourselves in a wider valley draining from a cirque of high snow peaks on the east, evidently near the head of Wood's valley "D". Here at last we discovered fuel.

The next morning we paid off the caravan, and took stock of casualties. Twelve of the hired ponies had died from various causes, and three of our own, making altogether a proportion of a little under ten per cent, which, considering the utter desolation and the high altitude, could not be counted excessive. The men were all fit. They accepted their payment cheerfully, and one, Ali of Hondar, from the Shyok valley, agreed to return with fresh ponies at the end of our explorations. Then, with many expressions of farewell to the porters and many cries of "*Jule*" to ourselves, the caravan departed homewards.

We were left with our twenty-four porters and eighteen ponies. But the latter required a day's rest before we could move on down the valley. Up till now, we had been able to form a programme; the accumulated experience of previous explorers had enabled us to foresee checks and difficulties, and in some measure to prepare for them. But from now onwards, our plans had to be more elastic.

I had intended to establish a depot camp at the point we had now reached; to leave the Khan Sahib to commence the survey, and Clifford and Cave to carry on their collections and to support us; and to push on at once down the river with a light camp with Minchinton, in order to solve its riddle. The most I could make with my transport was a journey of five days out and five days back from my depot, if the survey was to be carried on in our absence. During this rapid reconnaissance I hoped to gain sufficient

information to lay out a programme.

But this intention had to be modified by the condition of the ponies, and by a report which Clifford brought in on the evening of the fourth that the valley appeared to be blocked.

The fifth of July was therefore devoted to clearing up the situation. The Khan Sahib was away just after six o'clock climbing the ridge above camp, from which he hoped to recognise some of the distant points fixed by previous explorers. The rest of us started soon after for the main valley, carrying, amongst other paraphernalia, the bipartite canvas boat which we had brought with us for crossing flooded rivers.

We soon reached the main valley, three-quarters of a mile below the depot. The junction beyond the little gorge lies in a broad stony amphitheatre, varying from three hundred to six hundred yards wide. The combined streams take a direction a little north of west and flow in a large number of channels.

I carried out a rough survey as I went. A mile and a half below the junction, we noticed a level line on the slopes on each side of the valley. Starting at the level of the flood plain, it gradually mounts the hillside, as the valley floor sinks. The river then enters another small gorge, after which the valley again opens out, and more parallel lines below the first become visible along the hillsides. Four miles from the junction, a large valley enters from the south, the valley walls recede, forming a flood plain half a mile wide, and the combined river changes direction to a little more north of west.

We rounded the bend and stood amazed. The hills on either side sloped up at an angle of thirty degrees, framing the flood plain. Beyond, and at a distance of some two miles,—though, since we took long to accustom ourselves to the magnitude of the scale, it looked much nearer,—we beheld the glittering blue waters of a lake. Beyond, again, stretched a mass of huge seracs, an army of white spires of ice, athwart the whole breadth of the valley. Behind and again beyond, rose the higher slopes of the valley, with caps of the purest white; and most wonderful of all, far away,—so far as to appear translucent, even through that empty atmosphere—stood the “Hidden Peak” of Gasherbrum.

We hurried on to the edge of the lake, passing first great blocks of ice and then mud flats. Now we could appreciate more fully the contortions of the glacier beyond, and its pinnacles of ice.

The snout of the glacier was over two miles from the near edge of the lake. We reconnoitred it by boat in the hope of finding a channel between it and the northern cliffs. But it was pressed hard against the wall of marble and at its base lay a chaotic mass of icefloes.

Above us towered the wall of the glacier to a height of three hundred feet. Minchinton, “scenting” icework, had pushed on

ahead and impatiently attacked this wall alone. From below we watched him pick his way up till, very small and insignificant, he reached what might be described as the surface of the glacier, though to us it appeared to be merely a rift between two amazing spires of ice.

In a letter written after the expedition to me Minchinton described this moment as follows :—

"Never before has such a wonderful sight suddenly burst upon me. After climbing the wall of the glacier, I found myself on the edge of the most chaotic maze of ice pinnacles that can be conceived—not mere seracs left between the cross crevasses, but a vast interminable sea of huge ice towers, forced upwards towards the heavens. Never before in my life, never among the glaciers of the Alps, of New Zealand, or of the Himalaya, had I seen such a terrible example of ice-pressure. The way was blocked at once ; there was no conceivable passage here. I could not even guess the width of the glacier. It might be a hundred yards across ; it might be miles. Clearly before attempting it, we must reach some higher point, and get a clear idea of what was before us."

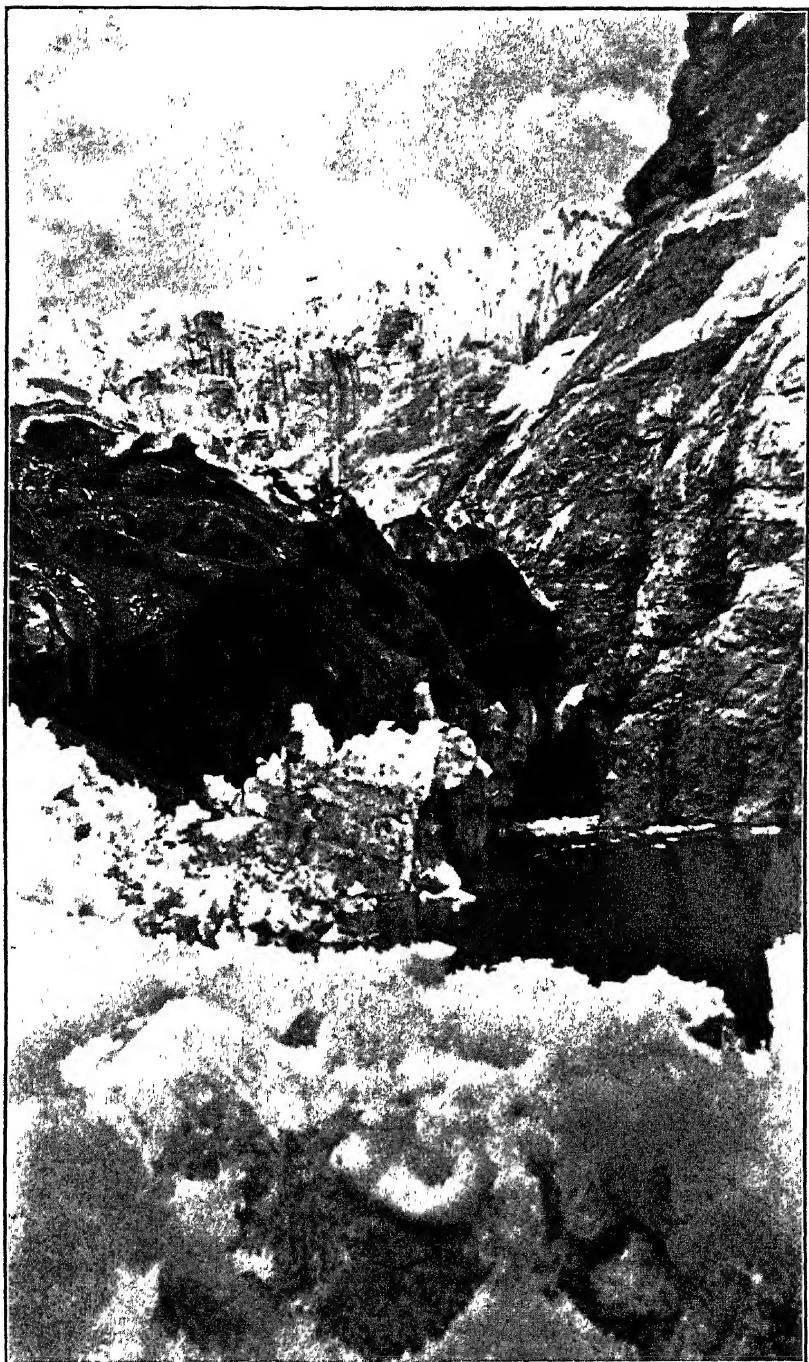
Minchinton did not remain long upon the glacier. As he commenced the descent, there was a report like a thunderclap, and a pinnacle of ice fell away into the lake, fortunately not in his immediate neighbourhood, and soon afterwards he rejoined us.

We recognised that this glacier was going to be a serious obstacle, which would necessitate a thorough reconnaissance before we could make our dash down the valley. It was decided therefore that Minchinton and Cave should carry out this reconnaissance, while the Khan Sahib and I surveyed the upper reaches and tributaries.

Kunchuk, our excellent scout, was taken ill on the return to the depot, and had to be brought in on a stretcher. Clifford was anxious about him, as we sat up late into the night, and it seemed at one time possible that an operation might have to be performed. But he cheerily passed the crisis, and Clifford made a friend for life. The rest of us shared a reflected glory ; and our luck became proverbial in the camp.

The next few days were spent with theodolite, camera and planetable surveying the head-waters of the river and its tributaries. We found that the southern affluent which we had passed on our way to the lake drained from a considerable glacier, with pinnacled ice, and having one source at a low depression at the head of the northern branch of the Rimo glacier, which had been explored in 1914 by Sir Filippo De Filippi.

The easternmost tributary, the continuation of the main valley, into which fell the waters of stream "H", just below our depot, was fed by glaciers lying on a high snowfield about ten miles to the east. Several tributaries, of no great size, drained the mountains on the north of the valley. They lay in troughs tucked away behind the outer spurs.



THE KYAGAR GLACIER SNOUT HARD PRESSED AGAINST THE
“RED WALL”. PHOTOGRAPHED FROM A FLOATING SERAC.

The Kyagar Thso, "the Grey-white Lake", so called by our men, still carried the remains of its winter ice, besides the fallen seracs which floated on its surface like miniature icebergs. The pressure against the dam must be very great, but the glacier spreads at the snout to a width of two miles and is able to withstand the pressure. Then before the water overtops the ice the brief summer is over, the land becomes frost-bound and the lake freezes. For six months probably, no water flows into the lake, and none flows out.

About a mile from the edge of the glacier, a narrow tributary, the "Kyagar Creek", entered the left shore of the lake. Between this stream and the glacier lay a high ridge, composed mainly of loose shale, and about a thousand feet or so above the valley bottom.

On the sixth of July Minchinton and Cave left the depot with two Gurkhas, Tilak and Tek Bahadur, and some porters carrying a light camp. Pitching this at the near shore of the Kyagar Thso, they wound up the southern slopes bordering the lake, descended into the Kyagar Creek, and climbed the slopes of shale to the west. A tiring scramble brought them to the summit, where a cairn was built for survey purposes.

At the foot of the ridge, flowed, rolled, jumped and tossed the chaotic stream of the glacier. For five or six miles from its snout, it presented an amazing spectacle of ice pinnacles, rising above the "surface" of the glacier to a height of two hundred feet, while near the end, these reared themselves even higher. Occasional pools of clear sapphire-coloured water,—large lakes in reality, though dwarfed by the magnitude of the scale,—lay almost hidden amongst the towers of ice. Rare patches of moraine, medial and probably longitudinal in origin, added mystery to the tumult, but every "lead" that was examined ended in impassability. The snout was hard pressed against and had cut into the marble wall across the valley, and occasionally great masses of ice would break off and fall into the Kyagar lake.

The main trunk of the glacier is formed by three large glaciers, not to mention the smaller tributaries, descending from the Apsarasas group of the main Muztagh-Karakoram range. This group, rising to over 23,000 feet, was surveyed on the south by Grant Peterkin, with the Workman expedition of 1912. On the north, now seen for the first time, the range is draped with glacier ice, clotted, twisted and torn, with steep broken icefalls and bergschrunds.

The three main feeder glaciers are separated by two long promontory spurs, projecting boldly to the north. The westernmost glacier swings round from the northern face of Teram Kangri, which from this side shows a great rounded snow-cap, seamed with bergschrunds, impossible to climb.

The ice of the three glaciers is, at the junction, suddenly

compressed into a smaller trough, two miles in width. This fact, combined with the natural tendency to pressure ridges, is largely responsible for the amazing chaos lower down.

There appeared one chance of crossing the glacier. From the westernmost promontory there showed for some distance a depressed corridor, the floor of which was covered with moraine. If a way could be found or cut to this, it might be followed up to the promontory, whence it seemed that the left side of the main glacier might be reached by crossing the Teram Kangri branch above the limit of the pinnacles and crevasses.

Minchinton and Cave reconnoitred a way down from the ridge to the glacier, and after leaving a cache of equipment, ropes, crampons, and cameras they returned to their camp by the Kyagar Thso.

The following morning, July 7th, the same two with Tilak Bahadur and some porters, left camp at six o'clock. By nine, having left the porters on the ridge with orders to make certain cairns for survey work, the three of them picked up the equipment at the cache, put on their crampons and struck out into the glacier.

Not till this moment did they realise the enormous size of some of the ice towers and the tremendous difficulties before them. On every side they were enclosed. An opening to the right was frustrated by a lake of the most indescribable beauty, turquoise and sapphire depths reflecting the giant icicles. On the left a hopeful passage was thwarted by a rampart of frozen spires. Then for two hours they struggled and wrestled with the chaos, lost in a world of ice. The maze of pinnacles and towers seemed set without order. They were of every size, of every conceivable shape, all indescribably beautiful and awe-inspiring; some massive and solid, some tapering and towering up hundreds of feet to a splintered needle point; some with polished translucent ice, refracting all-coloured light from amazing depths; others cracked and split, and carrying a fairyland of icicles.

There were some beautiful ice-grottoes and deep caverns. One, through which the party passed, was thirty feet long and guarded by fragile pendant ice. Here and there among the confusion, tumultuous streams thundered through tunnels to the edge of a chasm, and disappeared into the bowels of the glacier.

For four hours progress was made in one direction or another. It was no easy matter to keep direction, for rarely could any view of the surrounding mountains be obtained, except by laboriously climbing a tower.

Soon after one o'clock Minchinton estimated that they had worked up the glacier about three miles and had penetrated nearly a mile towards the centre of the glacier. At this point they struck another corridor, a good deal to the east of the one they had been aiming for. From the subsequent photographic survey of the glacier, it is almost certain that they were not half a mile from the near

edge, at the outside.

They were now in the depression, some fifty yards wide and floored with moraine and black ice, which descends from the eastern of the two Apsarasas promontories. The corridor led southwards in a succession of gentle waves or steps, separated by small icefalls, and enclosed by towers similar to but smaller than those on the body of the glacier.

The party halted here for food. In spite of the surrounding world of ice, it was quite hot within the corridor. Insects of the mosquito class caused a minor annoyance, and an occasional butterfly, a painted lady or a common white, fluttered by. Sometimes the silence was profound; then there would be the tinkle of splintering ice, falling into the depths, or the "plock" of a stone; occasionally the quiet would be broken by the thunderous roar of a tower, as it crashed from an unstable base.

After the halt, Minchinton pushed on ahead of Cave, one of whose crampons had broken, in an attempt to reach more level ice. But at three o'clock he was forced back by the lateness of the hour. Before doing so, he cut steps up a neighbouring pinnacle.

The pinnacles were already smaller than before. Minchinton estimated that in another half mile or so, he could probably turn right-handed, and possibly reach the promontory between the central and western glacier.

On the return they followed the corridor to the lateral moraine of the main trunk, and without much difficulty reached by four o'clock the point where this moraine issued to the eastern side of the glacier. This time makes it probable that the direction outwards had been less westwards than was estimated, a probability borne out by the subsequent survey.

Most glaciers in the Karakoram are blessed with a lateral valley or depression between them and the hillside, especially where the midday or afternoon sun has full play on the bare rock opposite. But there are exceptions, and the Kyagar is one of them, the ice of the main trunk being so confined after the junction of the three branches that it is forced over the lateral moraine, the towers becoming crushed against the walls of rock.

Progress was most difficult. At length, on rounding a small spur, the party reached the top of an ice-cliff three hundred feet high, falling sheer to a glacier lake. With much labour a track was cut back to the body of the glacier, and at last the cache by the foot of the ridge was reached, nine hours after it had been quitted in the morning. At six o'clock, the party, much exhausted, began the ascent of the steep shale slope. Two hours later they reached the summit of the col, and at half-past ten, they were carried across the swollen river into camp.

Minchinton reported that nothing but the lightest camp could be taken over the glacier. Under no circumstances could a way be

made passable for animals. For a party on foot, a forward camp would have to be placed at the near edge of the glacier, and another taken to the foot of the eastern promontory. In all probability a third camp would have to be pitched on the far side before the main valley could be gained. That is to say, the reconnaissance of the passage for men on foot would occupy three more days at least, while to clear a route for laden porters would probably take a week. He also reported that if a route were cut, it would be extremely difficult to keep open as a line of communication.

We now held a conference. The survey being well started, it was decided that Minchinton and Clifford should reconnoitre the tributary, afterwards known as the Lungpa Marpo, which joined the main valley just below the junction of valley "H". Cave and I were to go back to the Kyagar glacier with the Wild outfit, and survey down the valley by photography as far as possible; and I was to form an independent opinion as to whether it was worth while forcing the glacier with a small party.

On the tenth of July, Cave and I pitched camp in Kyagar Creek. In the afternoon we carried the survey instruments up to the cairns on the ridge.

Then for the first time I saw the view that Minchinton had found impossible to describe. And no wonder, for words are inadequate. For a moment the surging confusion of the glacier dazzled us; but our gaze was drawn to the valley beyond the snout, where it opened out once more. Then lower down, twelve miles from our station, a second glacier, probably from Teram Kangri, thrust forward its snout, though I do not think it quite blocked the valley, for I could see no lake. Beyond, again, the valley widened and at a range of twenty-four miles the torn surface of yet another glacier stretched into the valley from the south.

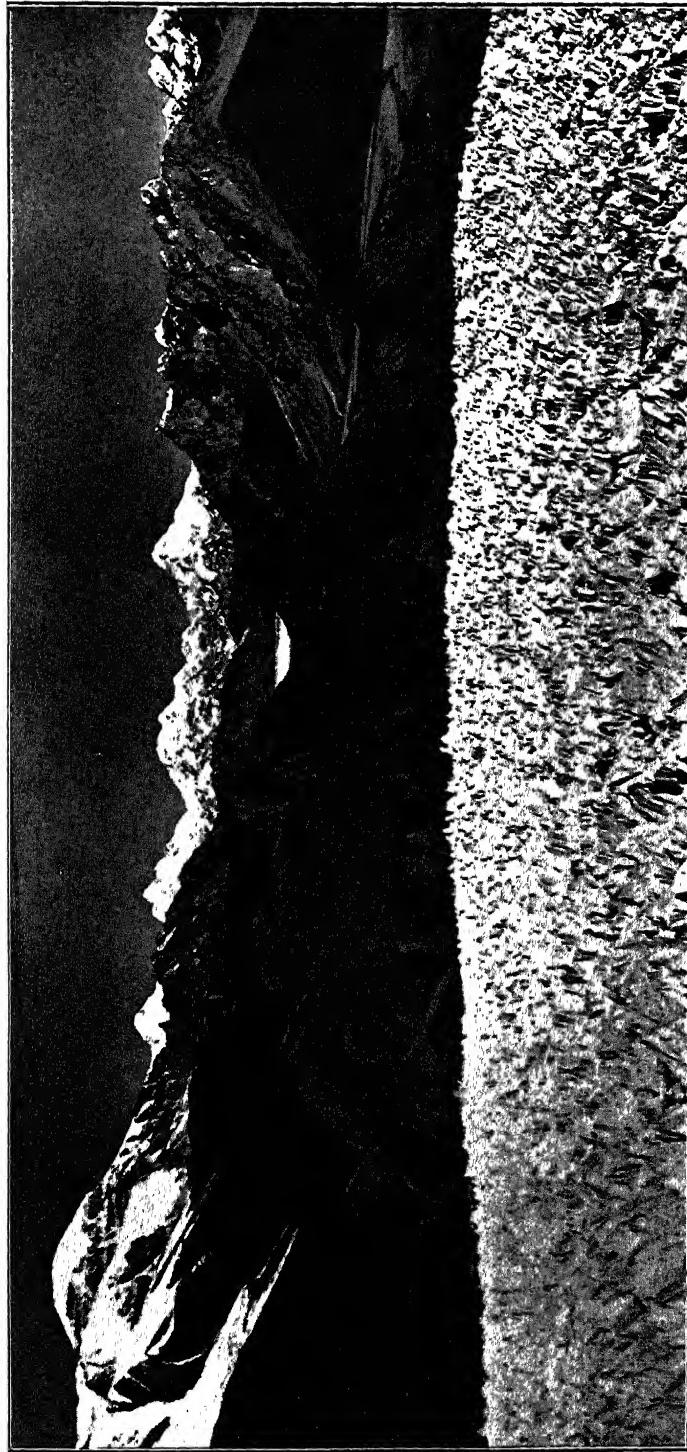
The scale was immense, and the eye travelling over these miles of mystery rested on the sublime wonders of the distance.

At the far end of the valley the four mighty monarchs of the Muztāgh lay before us in their divine purity. Gasherbrum I on the left, 26,470 feet,—the "Hidden Peak" of Sir Martin Conway, hidden and shy from the west, at last revealed; the lesser Gasherbrum II, 26,360 feet; the mighty "Broad Peak", higher than the last and next in the line; and then, the miracle of all, the perfect cone of the second highest mountain in the world, the nameless K², 28,250 feet above the level of the sea.

For a long time we remained motionless, silent, insignificant, ourselves and our men. Buddhists, Hindus, and Christians were alike bound by the same divine spell, cast by the single Providence, which had led us here. And as I stared, there came to me a surging sense of gratitude, deep and overwhelming, that I had been permitted this fulfilment of a dream.

Which of us now can speak of that grip on our hearts? Surely,

GASHERBRUM "BROAD PEAK" K²
I. 26,470 II. 26,360 26,400 28,250



ACROSS THE KYAGAR GLACIER AND DOWN THE SHAKSGAM VALLEY
THE ICE-PINNACLES ARE FROM 200 TO 300 FEET HIGH; K² IS 42 MILES DISTANT.

began to bend in the same direction, and must eventually cut across the line of the Island Ridge.

We examined the Red Wall, hoping to find some way across it. In the early morning light we could see signs of two gaps. The first, not far from the snout, was probably a minor depression between two peaks of over 21,000 feet. But at a distance of perhaps some ten or twelve miles, a flood of sunlight appeared for a few minutes across the valley, indicating a deep depression, possibly the gorge of a river, cutting through the wall.

This discovery led us to hope that if we could cross the mountains to the north, above the glacier block, we should be able to recross them again through this gap and regain the valley lower down.

The weather was now set foul, and there seemed to be no sign of a change for a day or two. A letter from Clifford reported that Minchinton had been taken ill on the glaciers of the Lungpa Marpo, but that he was now recovering. They had come to the conclusion that a route could be made over the glacier into the head of Wood's valley "I".

This last was great news, for Wood had reported an easy way over the head of this valley to the country beyond. We felt therefore that by taking this line we should circumvent the glacier without much difficulty.

CHAPTER III

THE LUNGPA MARPO AND LUNGMO-CHHE

MENTION has already been made in Chapter I of the Amphitheatre of the Yarkand river, explored by Major Wood in 1914. Below this amphitheatre, two large tributaries, called by him "I" and "J", entered on the left bank. A greater contrast than that between these two valleys could hardly be conceived.

The tributary "J" was reported to flow in a narrow difficult gorge, confined by almost continuous walls, and to contain practically no grass or burtsa. The enclosing hills were also extremely barren, and only one single patch of grass had been found.

The river "I", which became known to us afterwards as the *Lungmo-chhe*, "the Big Tributary", on the other hand, flowed in a broad bed enclosed by a wide valley. Grass was reported to be plentiful, game-tracks numerous, and the lower slopes gentle.

Between these two valleys the land was *incognita*. It covered a large area, and therefore we considered that it must be drained by a large stream. No such stream had been observed by Wood to enter "J" or the Lungmo-chhe. The wish was father to the thought, and we rashly assumed that this stream, which we called for convenience, before we knew of its existence, the "I-J" river, must cut across to the west of the Lungmo-chhe and fall into the main Shaksgam.

At my request, before the start of the expedition, Wood had marked on a copy of his map, certain red crosses at the end of tributary streams of the Lungmo-chhe. These crosses indicated the most likely points of access from outside. But Wood was only in the Lungmo-chhe for two or three days, and we had already found that the tributary which gives most promise of a route when seen from the far side, was blocked by a glacier low down near the Shaksgam, rendering it impassable for ponies and most difficult for laden men.

Almost opposite the river junction below our depot, a narrow tributary entered the Shaksgam from the north-west. This, called by us afterwards the *Lungpa Marpo*, "the Red Ravine", contained a boisterous stream issuing from a glacier snout of the pinnacled type. From one of my stations above the depot, I had examined it

and the route over the glacier had appeared practicable. Minchinton and Clifford explored it on the 11th July.

The glacier was the off-side saddle-flap of a typical "saddle glacier", whose cantle lay some six miles away to the north-west, resting among a group of peaks over 21,000 feet in altitude. The near-side saddle-flap was thrown over the watershed into the southern head of the Lungmo-chhe.

Minchinton and Tek Bahadur reconnoitred this glacier to its "cantle", in an attempt to find a pass back into the Shaksgam directly below the Kyagar glacier. They reached the col at the end after an exhausting time on the softening snow. A steep icy descent on the far side gave birth to a glacier flowing in a north-west direction. Minchinton believed that he could have taken a party of laden porters to the glacier below with much difficulty; but at the time, in view of Clifford's report he did not consider the attempt worth the effort, especially as the glacier appeared to bend towards the north rather than to the south. He suggested that this exploration should be deferred. Unfortunately no subsequent opportunity presented itself to do so, but it seems possible now from the survey that there may be a climber's route back into the Shaksgam from here.

Clifford meanwhile examined the saddle and the far saddle-flap, which drained as we had hoped into the Lungmo-chhe. He reported the route to be easy and quite suitable for porters.

It was now nearly a fortnight since we had crossed pass "G". We had completed the survey of the upper Shaksgam, and reconnoitred all the branch tributaries. The river was rising considerably, and the lake had extended five hundred yards in length. The amount of grass had not fulfilled our expectations, and was now almost exhausted.

A fourth pony had died, and the rest, though on very light work and getting a double ration of barley, were very thin and weak. The weather, too, had turned against us. Snow whitened the surrounding slopes, and covered our dump in the valley bottom.

We therefore definitely abandoned our project of descending the Shaksgam, after full consideration and with the agreement of us all. We did not admit defeat, but we felt convinced that if we forced the Kyagar glacier we must sacrifice all our animals, merely to score a barren, if spectacular triumph. Minchinton, whose personal interests lay mainly in climbing, was disappointed and afterwards regretted the decision. But at the time he agreed that the results would not justify the waste of time. No more knowledge of the main valley could be acquired with the resources at our disposal, than that which we could obtain from the photographic survey.

Our alternative plan promised far better prospects. This was founded on the formation of a new base in the head of the Lungmo-chhe. Supplies would be moved to the head of this valley, partly

by porters by the Lungpa Marpo route, and partly by ponies under Clifford and Cave, by the Yarkand valley. When reassembled at the new base, we would cross the north-western head of the Lungmo-chhe, reported by Wood to be easy, strike the "I-J" country, and force a way back into the Shaksgam valley below the glacier block by the "Hole in the Red Wall" if it was humanly possible. Failing this, we would strike the alignment of "the ancient route between Nubra and Khapulung"—if there was one.

This plan would also enable us to explore the ranges of the Aghil from the north side, and complete the survey of the "I-J" and "J" basins.

But first we had to complete the survey from the ridge east of the Kyagar glacier. This had been interrupted by the recent bad weather. The 14th was another foul day; we barely left the shelter of the depot. There was a big fall of rock into the valley below the camp, a reminder of the unfinished state of the country, and a warning to those who needed it. We spent the day computing our observations, developing our photographs, inking up the survey, and completing our future plans.

The next day the weather improved. Clifford set off with the weaker animals for a grazing ground near pass "G", while the rest of us returned to the Kyagar lake. We rose at three o'clock the next morning and started for the stations.

Crossing a spur on the south of the lake we had a wonderful view of the sunrise on Gasherbrum. From a steely grey against the dark night sky, the "Hidden Peak" was once more revealed, quite suddenly, gold and crimson. Then, on a day when not a single cloud marred the whole purity of the heavens, we worked joyously at our instruments from half-past six in the morning until five in the afternoon.

The Khan Sahib, too, worked feverishly, as though on this one day every detail of that vast landscape must be committed to the map.

During the day Minchinton and Tek Bahadur reconnoitred a small side ravine which entered the Kyagar lake opposite. They found it very confined and had to rope for the ascent. They were finally completely checked by a high waterfall, issuing from a glacier whose ugly snout threatened them with falling stones.

On his return to the lake, Minchinton at once moved off again to the Lungpa Marpo, in order to make a last thorough reconnaissance of the pass before we finally committed ourselves to a change of plan.

Snow fell almost continuously for the next two days, but it mattered little, for we had now finished the survey. Both days were spent in moving the supplies from the depot to a new dump near the snout of the Lungpa Marpo glacier.

The next morning we separated. Minchinton, the Khan Sahib and I took the porters to a camp by some small lakes up the northern

slopes of the Shaksgam valley, while the others started back with the ponies for pass "G". At the depot, the remaining supplies, necessary for the return journey to Pānāmik, were covered with a pile of stones, to protect them from ravens and wolves.

Two more days were spent carrying loads by hand up the Lung-pa Marpo. The route lay along the right side of the glacier, past the snout of detached pinnacles and by a series of unstable seracs, overhanging the lateral moraine, a somewhat unpleasant place owing to falling stones. The pinnacles were insignificant after those of the Kyagar; and we were hardly prepared for the difficulty caused by them less than a month afterwards, when several collapsed.

Beyond this point there was a steep lateral moraine, which formed an easy route to the site selected for the camp. Tents were pitched on the glacier itself, which was thinly covered with debris, in order to avoid the danger from falling stones.

On the 23rd we crossed the saddle—the Marpo La—at an altitude of about 18,500 feet. There were no crevasses of any consequence, and we made rapid progress over the hard surface, the Khan Sahib surveying en route. We descended to the 18,000 feet level by the left side of the Lungmo-chhe branch of the glacier, leaving a great red mountain of crystalline conglomerate and marble on our left.

From here we sent the porters down with the camp to the junction of the two head feeders of the Lungmo-chhe, with orders to pitch the tents and explore for fuel.

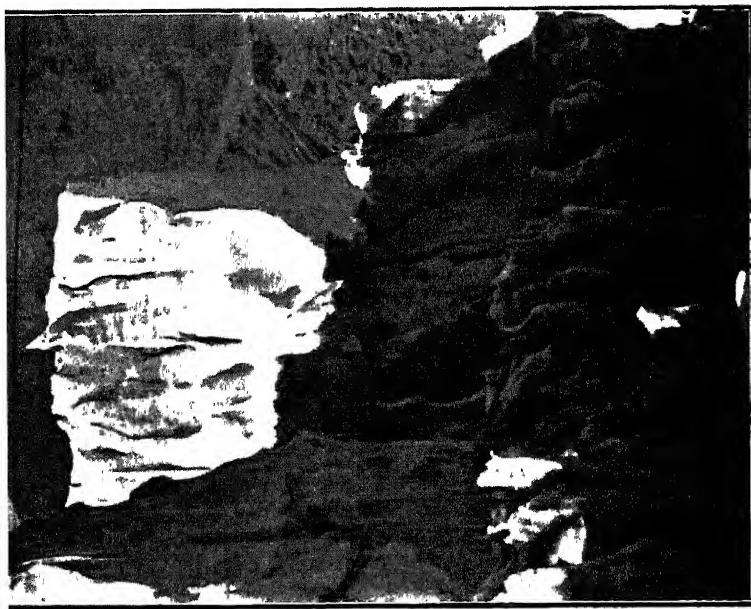
The rest of us,—Minchinton, the Khan Sahib, Kunchuk, Tilak and I—traversed the mountain side to explore the north-western source of the Lungmo-chhe.

Wood in 1914 did not explore this source himself and his remarks are from hearsay. From no fault of his, they are somewhat misleading and incomplete. There are two large glaciers, not one, which send down long streams of broken ice to the watershed. We climbed on to the first glacier at about 18,200 feet by a lateral moraine, and crossing to its centre discovered the second.

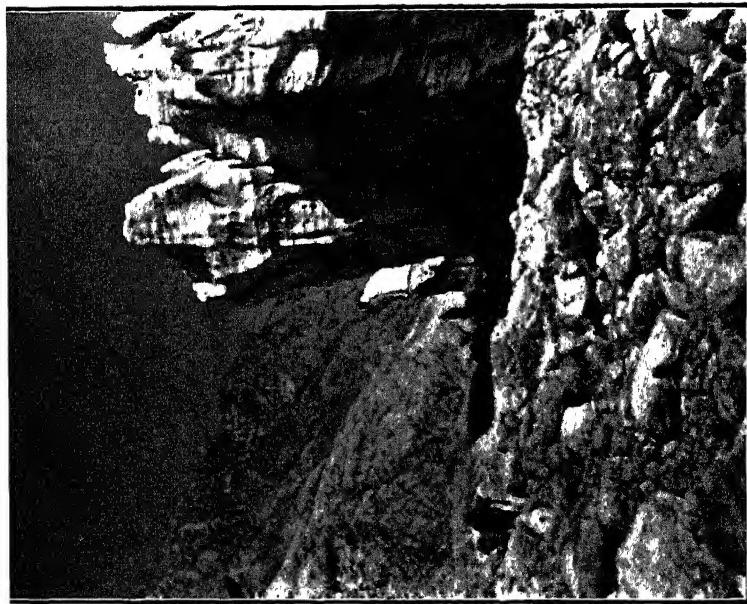
We could see that the two joined some distance below us, and that the combined snouts were hard pressed against the hillside opposite; and it looked even from here that the passage was not so easy as we had been led to expect; but we saw enough to know that we could cross them both high up if necessary.

There was still about three feet of winter snow on the glacier, and we had to feel for crevasses. The glacier we were on rises from a very grand group of red marble peaks, clotted with ice, 22,000 feet high. The valley draining the second glacier could not be properly seen, and we were unable to determine its course. The mystery of the "I-J" valley was still unsolved.

We now examined the snout of the first glacier at close quarters. Wood wrote, from what he was told: "Like the glacier



TERMINAL ICE-TOWERS OF THE
SA-KANG-LA GLACIER; 200 FT. HIGH.



LATERAL SERACS OF THE LUNGPA
MARPO GLACIER, ABOUT 80 FT. HIGH.

at the source of the other branch" (*i.e.* that forming the Marpo La), "this too sends tongues into the valleys on either side of the pass. This latter is quite practicable for animals, as the glacier neither blocks it nor the valley, but rests on the southern slopes, leaving an easy passage. It is very similar to the pass "G" near the Remo snout of the Yarkand river".

A close reconnaissance unfortunately proved that this was altogether too rosy a view. From the stream below the glacier we looked up at a snout of towering seracs, at the north side of which was a narrow passage over a maze of fallen blocks of ice. The ice at the extreme end was perched and tottering on a rocky outcrop, which had been cut through by the glacier stream. The glacier itself was of *living ice*, and at any moment we expected to see a pinnacle crash to the valley.

We made our way up the terminal defile, which was quite impracticable for animals, over huge blocks of ice and under the pinnacles, but were checked after going about a hundred yards. We were faced by a wall of rock sixty or seventy feet high, over which the stream poured in a waterfall. Climbing the hillside north of the fall, we came upon two small cairns, which must have been built by Wood's men, and showed that they must have taken a higher level. We therefore now kept to this level, crossed a shale spur, and were brought to a halt by a considerable lake, filling a gap between the glacier and a bay in the hills. After reconnoitring a short way beyond, we returned to our new depot by a high route, which we decided could be made practicable for animals, provided further examination of the second glacier snout presented no greater difficulties.

The porters had to be sent back now over the Marpo La in order to stock the Lungmo-chhe base; in fact from now onwards until the end of the expedition any porters that could be spared were engaged on this work, and it remained an everlasting difficulty and anxiety to keep the supply of food and fodder sufficient, and still retain enough men to work in the forward areas.

Meanwhile, for the next two days we continued the reconnaissances both down the valley to make certain it was practicable for Clifford and Cave with the ponies, and over the glaciers at the head.

The first showed no difficulty down the Lungmo-chhe. The gorge was easy and the valley was extremely fertile—for this part of the world—with grass and burtsa. At some period of the year, probably in the winter, animals must congregate here for shelter, for in many places the dung of wolves, burrhel, yak and kyang lies together in the same sheltered but sunny spots. The valley is crossed by game tracks in all directions, and butterflies were beginning to be common. The Tibetan snow-cock and many smaller birds were now in the valley with their broods. It was an ideal spot for our new depot.

Further reconnaissance up the valley showed that this plenty ceased at the gorge below the junction mentioned by Wood. Beyond,

there were no tracks, no fuel, and very little bird or insect life. We found however a number of marine fossils. The second glacier was discovered to block the valley completely, and had torn out the hillside opposite, forming impassable cliffs. Laden porters might still find a way over them high up, but for ponies there was no practicable route.

We therefore fell back on the crossing high up the glaciers at a level of about 19,000 feet, well above the serac'd portion; but the long day's reconnaissance which took us into the valley beyond, cleared up no mystery. We could not see where it led, and in such a land it was futile to guess; nor could we say whether it contained grass or fuel, though we could find no signs of life.

Clifford and Cave arrived at the head of the Lungmo-chhe on 26th July, just as we were beginning to get anxious. They had wisely taken their marches leisurely, owing to the weakness of the animals. Two more of these had died, but the remainder had benefited by the young grass which was now springing up in the Yarkand valley and Lungmo-chhe. They reported the interesting discovery of the corpse of a man in the latter. There were two rupees on him, one of which was dated 1918, and a string of turquoisees, so he had evidently died unattended.

A little way from the body were six tins of aniline dyes, unopened, and bearing the device of a lion and shield. The man was huddled up, and Clifford was of the opinion that he had died of starvation and exposure about the year 1924. We afterwards came to the conclusion that he was a Balti, and from later discussion with traders surmised that he had straggled from a caravan some five marches to the east, lost his way and starved to death.

The discovery was of interest in view of the rumours of the ancient route. Wood had found a saddle-bag with a Koran and letters in valley "J", and had been tempted to use this as evidence of a through route still occasionally in use. I am myself more inclined to think that his relic too belonged to some straggler, for the owner was never traced.

Clifford and Cave had considerably increased their collections of plants and birds, and brought specimens of rock which contained metallic ore. They had encountered a large number of burrhel and antelope, and brought us fresh meat, of which we were much in need.

When we were reassembled we again reviewed the situation, and concluded that it would be better for Minchinton, the Khan Sahib and me to reconnoitre and survey ahead, owing to the uncertainty of the route and lack of grass, while Cave and Clifford supported us from our new depot and attended to the supply and transport problems on our communications. I think we made the mistake at this juncture of pushing on at once, before getting more supplies over the Marpo La; but the weather was fine and we were impatient. We parted company again on 30th July, the forward party

crossing the pass on that day with a light camp. We intended to be away a week at the outside, and having found a practicable route for ponies, to be back within this time in order to take forward a fresh stock of rations with pony transport. As matters turned out, there was no practicable route back to the Shaksgam. Instead of being back in a week, we did not return to the depot until September.

While we were away, Clifford and Cave made a thorough reconnaissance of the whole of the Lungmo-chhe tributaries and cleared up many of the riddles of the country north of it. About eleven miles from the junction of the valley with the Yarkand river, a small ravine breaks the line of the hills on the left bank. At the head of this, on my map, Wood had marked a red cross.

On the 2nd August, a reconnaissance was made of this col, which was a little over 17,500 feet high, easy and clear of snow. Beyond, the ground fell away steeply to the bottom of a deep valley. Immediately opposite, and with a steep limestone face, rose a rocky massif, culminating in a snow dome, the height of which had already been fixed at 20,600 feet.

The result of this first exploration was most puzzling. Both Clifford and Cave, though they studied the valley from all angles, were unable to say in what direction the stream flowed. Neither of them could see any possible outlet.

On a second reconnaissance, Cave and Clifford crossed the col and forced a descent into the gorge below. Only when they actually reached the water's edge, did they discover that it drained northwards, and that its source must lie in the high snowfields to the south-west. For four miles they made a tortuous way northwards along the gorge bottom, while the cliffs above shot rocks and debris at them. At one point they climbed out of the gorge and forced a way over the cliffs, but they were eventually checked by a precipice. These four miles took four hours. Throughout both reconnaissances, no tracks of game, no vestige of life, no signs of vegetation, were seen.

On the 13th August they made a further exploration over a pass on the northern watershed of the Lungmo-chhe, about four miles north-east of the previous col. On the far side of the pass, which was easy, they discovered a tributary valley about a mile wide, containing patches of burtsa, grass, game-tracks and dung.

They followed this westwards and then northwards, where its bed became steeper and it emptied into the gorge they had explored previously. Some distance above the junction, another fairly large tributary was observed to enter the gorge from the west, and the combined stream now took on a north-easterly direction. It flowed between high cliffs and was confined the whole way, the gorge varying in width from twenty to a hundred and fifty yards; and though the bed was passable for ponies, the water in the afternoon

came up to the ponies girths.

This combined stream was followed for about three or four miles northwards to its junction with river "J", which was here bounded on the north by a conspicuous red range, probably of sand-stone, stretching north-westwards as far as the eye could see. This river "J" had steep banks and flowed almost continuously in a gorge, but it seemed possible to Cave that a way could be found above the walls on the right bank where there appeared to be faint traces of vegetation.

Close to the junction with "J", burtsa was found, though the tributary which had been followed was entirely destitute of this and grass; and Major Wood reported "J" to be utterly barren.

These explorations proved that the eastern part of the "I-J" area drained into valley "J" and not westwards across the head of the Lungmo-chhe, as we had all assumed. They were confirmed by our own explorations and were of the greatest value in September when the Khan Sahib surveyed the whole region.

One further reconnaissance made by Clifford and Cave may be mentioned here. This was carried out to ascertain whether a route could be made practicable for ponies back to the Shaksgam by the tributary mentioned by Wood as containing two small lakes.

This valley has already been alluded to above as having been considered to offer the most likely point of entry to the Lungmo-chhe from the south. The pass itself was exceedingly easy; but the tributary beyond was completely blocked by a glacier of the pinnacled type. Cave reached a point above the glacier towards the end of August and obtained a view right down the Shaksgam. He observed that the Kyagar lake had during the last month extended up the valley a further two and a half miles, and that it was now over five miles in length.

CHAPTER IV

THE SA LUNGPA AND THE AGHIL DEPSANG

ON the 30th July the advanced party crossed the Sa-Kang La glaciers at the head of the Lungmo-chhe. We had already carefully reconnoitred the route and improved it by cutting an easy gradient for the animals. Nevertheless, to save them as much as possible, loads were carried on to the glaciers by hand and the animals taken up unladen.

At 5.30 a.m. the snow was hard and the crossing of the first glacier rapid; but the icy descent from it was too slippery for laden beasts and they had to be unloaded and lowered by hand. At 7.15 the caravan reached the tongue of rock debris between the two glaciers, and after zig-zagging up the slopes of the hill above, reached permanent snow.

A good view is obtained from this mountain-side above and between the two glaciers, which could be seen to converge below us on the saddle of the watershed. Their surfaces became more and more crevassed, rent and broken as they merged into one another, but their medial moraines also became more pronounced.

The eastern glacier, that is, the one seen by Wood's party, swung round into the Lungmo-chhe. The western appears to receive a greater pressure from behind, and, stretching across the saddle, impinges with great force against the slopes opposite, tearing out the rocks and forming cliffs.

We had already reconnoitred the snout and the lower broken reaches of the glaciers. We now kept to a level of nearly 19,000 feet. For a short distance before reaching the western glacier the snow was soft, but on reaching an ice foundation, good progress was made, in spite of the necessity for caution owing to covered crevasses.

It was 10.15 before we cleared the second glacier by a subsidiary snout draining into a tributary of the main valley. During a short halt for breakfast, we observed a very fine elliptical sun halo through the thin cirrus clouds. We camped about a quarter of a mile below the junction of this tributary with the main stream, after a somewhat exciting crossing.

The valley was more utterly barren and desolate than any place

I had ever seen. There was no life, and no signs of any; there was not a blade of grass, nor trace of any green thing. It soon became known to our men as the *Sa Lungpa*, "the Valley of Mud". We had been accustomed to limestone hills with disintegrated slopes of shale. Here the hillsides were covered with a hard dry mud, which must be viscous after rain or heavy thaw. Low down in the valley bottom these mud slopes are seamed with numerous scorings of streamlets, and on the flat the mud is baked and cracked by the sun.

In order to travel light and to provide men for our communications we sent back all but four ponies and six porters during the night; and in our eagerness to learn the secrets of the valley were ourselves on the move again as soon as it was light enough to see.

The *Sa Lungpa* continued in a north-westerly direction,—the acme of desolation. At a point about four and a half miles beyond our camp, we climbed a low hill on the right bank, and from this point observed that the river entered a deep gorge, breaking almost immediately into the mountains to the south-west. We therefore pitched camp beside a stream of clear water issuing from a deep ravine on the north.

The party then separated. Minchinton took Tek Bahadur up a clay hill immediately above the camp, while the Khan Sahib ascended the mountain-side north of the valley and made a planetable fixing in direct prolongation of the gorge. One of the ponymen, Ibrahim by name, came with me to explore the gorge itself.

There was a lot of water in the river, turbulent, clayey water, up to the ponies' withers. After fording it a dozen times, the walls closed in, and the way became blocked by enormous boulders. I climbed the cliffs to reconnoitre; but there was no practicable route for animals, and we were compelled to leave them behind.

We now proceeded on foot, jumping the torrent from boulder to boulder, many of which were covered with a thin film of ice formed by the spray. After making some progress in this unpleasant way, we would find the going easy for a hundred yards or so along one side or the other, over boulders, through the water at the edge of the stream or by traverses across the walls. Then we would be checked, forced to jump the stream again and try to advance by the other bank. Once, in fording the stream breast high, Ibrahim was nearly carried away, and we were forced to retreat a hundred yards in order to cross and gain fifty on the other bank.

Gradually, we gained about a mile along the bottom of this gloomy gorge, and after more than two hours reached a point where it opened out a little. Here, to our great disappointment, we found that the stream had scoured its bed, the water was too deep to ford and the current too strong. Our attempts to cross without ropes were fruitless. There was no way over the cliffs. We were forced to turn back.

My experiences on this day taught me a lesson I shall never forget. The outward journey had been difficult, and we had been lured on by the hope of success. The return was most hazardous, for the gorge now held a roaring torrent, and we were almost trapped.

On my return I had hoped to hear from Minchinton that we had passed the worst of the gorge, and that it would not be more than two miles long. If this had been so, we could, I think, have built a staircase track, and forced a way down in the early hours of the morning. But both Minchinton and the Khan Sahib saw from their stations that the gorge became even more confined, and remained so for a *further four miles* at least, enclosed by sheer walls. We were therefore forced to abandon the attempt as long as the river was in flood.

Thus ended our fortnight's attempt to pierce the Aghil ranges and regain the Shaksgam by the "Hole in the Red Wall". From what we subsequently learnt, we believe that this gorge continues much further than we then imagined, and that its waters, after grinding a tortuous course through the Aghil mountains, eventually join the Shaksgam below the Durbin Jangal of Sir Francis Young-husband.

However we were not beaten yet; and it was well that our base was being transferred to the Lungmo-chhe. In continuation of the trough of the upper Sa Lungpa, a tributary branch approaches the gorge, from a north-westerly direction, and cuts its own gorge before joining the one we had explored. Both Minchinton and the Khan Sahib, from their stations, had seen at the head of this tributary a high snow col which appeared either to lead towards the Shaksgam where this river curved towards the north-west, or else to face the line of "the ancient route". In any event, the exploration of this col must solve the riddle of the "I-J" country.

But there was no vegetation in the Sa Lungpa, and it would be unreasonable to expect any in the higher tributary. We therefore sent back our four ponies, which were extremely weak. They reached the glaciers of the Sa-Kang La, whence Clifford had them practically carried down to grass, and nursed them back to life.

That night the weather broke and snow fell. For the next few days we could see nothing of the surrounding hills and we were out of touch with our base. Clifford and Cave had difficulty in getting supplies over the Marpo La owing to soft new snow, and to a block in the route caused by the fall of seracs. The rivers were in flood, and a porter was swept away and nearly drowned. He was unfit to carry for several days. These troubles caused our own supplies to run short and we were forced to send the remaining porters back to the base. The Khan Sahib and I spent the days computing and working at the planetable, while Minchinton took every opportunity to reconnoitre.

By the 3rd August, only our cook, Habib Lun, remained with us. All supplies, except a little tea and some Meta fuel, with which to boil water, were exhausted. That afternoon the sun came out, and we carried the "Wild" equipment to our cairns overlooking the gorge, and fixed their position; and in the evening Tilak Bahadur arrived from the depot with eight porters bringing fresh supplies and fuel.

With these men the Khan Sahib took a light camp over the hills, some six miles in a direct line, to a spot where two tributaries combined to form the north-western branch of the Sa Lungpa. With the men he sent back, Minchinton and I followed the next day, after completing the "Wild" photography at our stations on the way.

We took the high-level route which we had already reconnoitred for some distance, in order to avoid the gorges. Outcrops of limestone showed that the general strike was north-west to south-east, proving that this trough lies parallel to strike. The hillsides are rotten and disintegrating very rapidly, and among the debris we found a number of marine fossils.

On the 6th August we carried out two investigations. Minchinton and Tilak Bahadur reconnoitred the southern of the two tributaries as far as the snow col at its head, while the Khan Sahib and I explored the northern one.

I will deal with our day first. A quarter of a mile from camp the stream issued from a gorge. At this early hour, 6 a.m., the clear icy water was barely up to our knees. In the first mile we must have forded it a dozen times. We then reached a very confined part where the stream poured over a small fall and we were forced to cut a diversion about forty feet up the wall to circumvent the obstacle.

Beyond this point the gorge frequently narrowed to a width of a few feet and was enclosed by high upstanding spires of limestone. But fortunately there was always some way over or round the obstacles. About a mile and three-quarters from the start a considerable tributary gorge opened on the left bank, and thereafter the passage became easier.

Half a mile beyond this junction the gorge ended abruptly and we entered a comparatively open valley forty yards wide with steep slopes of shale. Here to our delight and surprise we discovered the tracks of game—a sure sign of more open country and grass.

We would have been well advised to follow these tracks instead of keeping along the gorge bottom. We took the latter course and soon the valley closed in again. In places this new gorge was nothing less than a slit between vertical walls, and at one spot where we forded the stream breast high we could almost touch both sides at the same time. It was bitterly cold, for the sun never penetrated here, and almost as soon as we emerged from the stream the water froze on our clothes.

Then suddenly we were at the end of our troubles. We climbed out of the valley by a scree slope, and found ourselves on the edge of a plateau. For nearly seven miles towards the north, and for five miles from east to west stretched an open stony plain, the whole of it at an altitude of not less than 17,400 feet. We could have galloped ponies over it. Low stony hills emerged from its surface and the view was very similar to that on reaching the Depsang from Kizil Langar.

For the first time for a week we saw green living vegetation and at a distance of a couple of hundred yards a small herd of Tibetan antelope, females with young, gazed at us stupidly and trotted off.

The Khan Sahib was soon at work on the survey, while I was so numbed with cold that I stripped off my clothes and lay out for half an hour in the sun. There was hardly a breath of air and already the sun was hot.

The plateau was afterwards named by us the "Aghil Depsang". The hurried reconnaissance which I carried out that day left no doubt in my mind that it was drained by the headwaters of Wood's valley "J", thereby giving the basin of this river an area of at least 200 square miles more than we had previously supposed. In the space of an hour our conception of the whole country between the Lungmo-chhe and "J" valley had to be discarded. The "I-J" valley of our imagination had no existence in reality; and so too we had to surrender our hope of finding a way by it back to the Shaksgam.

The south-western and western boundaries of the plateau were formed by snow-capped mountains rising to over 20,000 feet, and beyond these we could see the serrated peaks of the Aghil ranges, composed of the same type of weathered-red marble and crystalline boulder conglomerate that we had grown familiar with. We had met the same formation first between Murgo and the Depsang. We might almost now be looking westwards from above Kizil Langar, so similar were the two plateaus and their surroundings. Both contain the same type of scanty vegetation, the same lack of burtsa; both sustain the same race of birds, butterflies and antelope. Even the streams are very much alike, and flow in the same type of "squelchy" beds.

Surely across this plain must lie the "ancient route"—from "Khapulung" Aghzi, up valley "J", across this Aghil Depsang, and over its western watershed, down to the Shaksgam. Our hopes and spirits rose once more at the very suggestion. Worries about supplies seemed to vanish, and once more we knew that we should not turn back until we had seen the other side.

Our return journey was simplified by following a game track and so avoiding the upper gorge. Minchinton reached camp soon after us after a successful day's exploration of the southern

tributary. This stream issues from a glacier about a mile above the junction, and carries a thick red sediment.

In order to avoid the lower reaches of the glacier which were of broken ice, and to get a general reconnaissance as soon as possible, Minchinton and Tilak Bahadur had struck up the steep shale slopes immediately west of the camp at 5.45 a.m. At the summit of the ridge enclosing the glacier on the north they passed the Khan Sahib's planetable station of the day before. Following the ridge they reached a snow-covered prominence about 19,500 feet above sea-level from where they had a fine view.

Immediately to the north spread the Aghil Depsang, which the Khan Sahib and I were then exploring. Beyond this and bounding the north of valley "J", stretched the dark red sandstone range discovered by Wood in 1914; and far away in the distance stretched the snowy crest-line of the K'un-lun. To the south ranged the serrated battlements of the Aghil mountains, and beyond, on the Muztagh-Karakoram range, stood the great ice groups of Apsarasus and Teram Kangri. Below stretched the glacier leading at a gentle incline to the snow col, their objective.

Minchinton and Tilak glissaded down the slopes to its surface, and, having roped as a precaution against hidden crevasses, ascended the main trunk to this col. On the far side a broken glacier was formed below the lip and drained into a deep valley, stretching in a north-westerly direction; and across a jagged ridge of rock rose the pyramid of K².

Minchinton returned to camp a sick man. We discussed the results of the day's exploration. He was at the time a little doubtful whether the glacier beyond the col was practicable, though we agreed afterwards, when we saw it from the other side, that a path could have been cut down by the edge of the ice. It would however not have been wise to put a third glacier pass between ourselves and our main dump of supplies in the Lungpa Marpo, especially as another letter arrived from Clifford that evening reporting further difficulties on the Marpo La. Minchinton also needed rest, and would be unfit to tackle strenuous ice-work for several days.

We therefore agreed that the best plan was to move up to the Aghil Depsang. Minchinton could then have the rest he needed while the Khan Sahib and I explored and surveyed the plateau. Meanwhile every porter who could be spared would be sent back to stock our camp on the Aghil Depsang, preparatory to a methodical move over the watershed into the valley beyond.

The next day we moved up to the plateau with a light camp which we pitched at about latitude 35° 59', longitude 77° 3' at the foot of a low hill. We retained four porters for our immediate survey needs and sent the rest back to bring up more supplies and burtsa. We were fortunate on this day in shooting two antelope and eight Tibetan sandgrouse, which helped the larder of the camp

in spite of the scarcity of fuel.

This fuel question became most acute in the days that followed. Wherever we moved, and wherever our porters went, every kind of root and dung was collected and experimented with. We found that if we mixed antelope dung with the roots of grass, dried in the sun, we could make our burtsa last about double the time it did if used alone.

On the 8th August, the Khan Sahib and I explored across the whole Depsang from south to north, and made two photographic stations, W 13 and W 14, on the hills near its northern boundary. On the way across, we were twice brought up by depressions 250 to 300 feet deep, cut by streams issuing from a glacier descending from the western watershed. This glacier seemed to me to be the remains of a more extensive system of glaciation, very probably an ice-cap, and to have retreated in recent years. It stretches today downwards on to the plateau, and has the appearance of a great crawling monster. Several streams issue from the glacier and are rapidly carving out depressions in the surface of the plain.

Beyond this glacier was a second, with a spread snout and much terminal moraine material. This cut a deep ravine to the north of our station. Beyond this again rose a high ridge, for the most part clear of snow, though ice-capped where it reached the 20,000-foot level.

The maze of flow and counterflow across the Aghil Depsang is impossible to describe, nor from our stations did the Khan Sahib and I agree upon the matter. It needed a further day's reconnaissance following out the courses of the streams to ascertain exactly the directions of flow. In point of fact, all the drainage of the plateau collects in two main streams, which eventually combine about four miles to the east of it. The southernmost of these two is increased before its junction by a glacier seven miles long, descending from the northern watershed of the Sa Lungpa. From all these observations it became certain that the whole of the "I-J" country must drain into valley "J", a conclusion which was shortly to be confirmed by a report from Cave giving details of his explorations, recorded in the last chapter.

But our eyes were turned to the west. It was in that direction that the Shaksgam lay, and somewhere over the western watershed must lay the way to it.

We scoured the face of the Aghil Depsang for traces of the ancient route, and drew a complete blank. There was however one depression in the watershed, lower than the rest, that seemed to offer an obvious line for reconnaissance as soon as we could procure more supplies from the depot.

CHAPTER V

THE TATAR LA AND THE ZUG-SHAKSGAM

THE western watershed of the Aghil Depsang, as has been mentioned, rises in places to over 20,000 feet. I formed the impression that the weight of the old ice-cap had depressed rather than eroded the ridge between the highest points. On these depressions rested the typical saddle glaciers with long branches crawling towards the plain.

One depression was lower than the rest. Its glacier had retreated further than the others, and the young ravine below the snout was older and deeper than its neighbours. This depression we now determined to explore, believing that if Hayward was right in asserting that the Kalmuk Tatars had been here, they must have taken this line to the valley beyond.

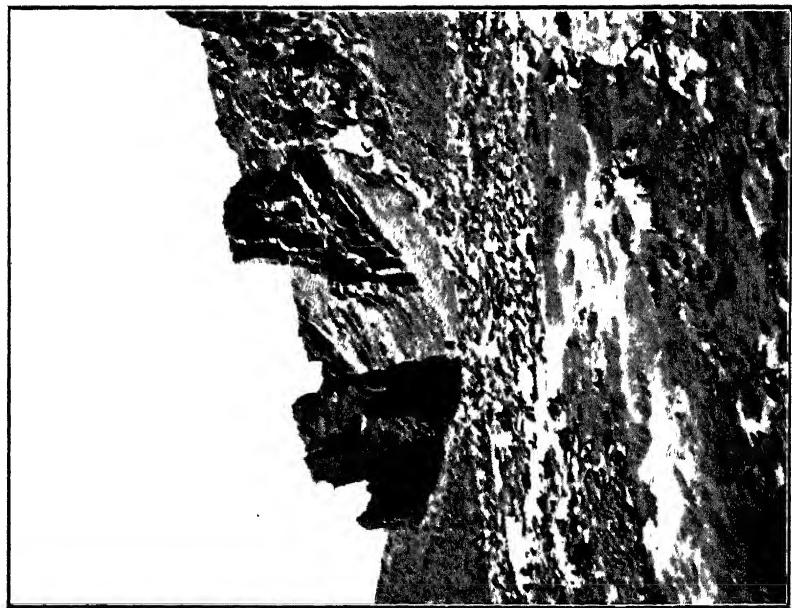
On the 10th August we moved the first part of the camp to the foot of the glacier, in the ravine, which we now named the "Tatar Lungpa". On the way we were more than once deceived by outcrops of limestone, which looked like cairns made by man. In places the rock was more crystalline than before, but generally the stratification was most regular, layers of limestone and sandstone enclosing a very crushed slate or shale. Throughout the whole formation, wherever we measured it, the strike was invariably NNW-SSE.

The dip was most irregular, and the rocks were split in every direction by frost. We found no fossils, but many of the boulders were rich in copper, which in our ignorance we mistook for gold.

The following day we explored the pass, the Tatar La. It was closer and easier than we expected, and there could never have been any hindrance to the Kalmuk Tatars, though we found no traces of them or other wayfarers.

Our route lay along the tongue of detritus about forty feet above the ravine. On the south, a glacier of the "saddle" type approached the pass, and swung its eastern off-side saddle-flap into the Tatar Lungpa, forming the snout by our camp, and enclosing a small glacier lake. Before reaching the pass, which was only two miles distant, we crossed to the glacier and from here ascended a low disintegrating limestone hill north of the col to reconnoitre.

Our view from the summit must have been somewhat different from that which Sir Francis Younghusband had from the Aghil pass thirty years before, but it could have been no less wonderful



THE TATAR LUNGPA.



GORGE NEAR N.W. SOURCE, SA LUNGPA.

than his, for our altitude was greater. Before us stretched a panorama of mountains and ice, so grand and so vast that it took the mind long to grasp its immensity.

From a little under 19,000 feet we looked across a deep valley—we called it the “Kalmuk Lungpa”—draining a little north of west. At a distance of about five miles, in a direct line, this valley turned either to the north or south, or joined the trough of a larger valley lying across it. At no point could we see the bed of the Kalmuk Lungpa, and we could not be certain whether the stream itself flowed in a gorge or not. But far down on the slopes, four thousand feet below us, evidently near the valley bottom, we could faintly trace through our glasses the tracks of game.

The large valley at the end was a sudden mystery. Whence did it come? Where did it flow? Did its river pierce the Aghil ranges to the south and would it lead us back to the Shaksgam, as had been our hope ever since we left the Kyagar glacier? Or was it a gorge? Of one thing we felt certain. At this time of year, the river would be at full flood, and its passage would not be easy.

At the head of the Kalmuk Lungpa was the small glacier, hanging from the col that Minchinton had explored from the Sa Lungpa on the 6th August. It was very steep and looked as though the ice had been poured like clotted cream over the lip of the pass. The surface was rent by crevasses, but we could trace a passable route downwards along its edge. On the south, the valley was enclosed by long spurs with steep slopes, projecting from a rocky ridge, which was draped with glaciers of a dazzling whiteness. Beyond this crest were a second and a third, carrying some fine peaks over 22,000 feet. To the left of these stood Gasherbrum I, the “Hidden Peak” of Sir Martin Conway, once more revealed in indescribable beauty.

At the far end of the Kalmuk Lungpa, and beyond the valley of mystery, the Aghil ridges continued. They culminated with a jagged ridge, 22,500 feet in altitude, precipitous and almost free of snow.

The details of all this vast landscape impressed themselves slowly, for the whole was dwarfed by the mighty pyramid, K², wonderful, mysterious, half veiled in cloud.

I made a station for the stereographic survey on this knoll by the pass, but was only able to take a few trigonometrical observations on this day, as clouds descended and covered all the great peaks. In the afternoon the Khan Sahib joined us at our camp, having connected his survey of the Aghil Depsang to that of Wood in valley “J”.

The threatening weather gave place later in the day to low clouds and sleet, and the next morning snow was falling. Survey work was out of the question.

When we left the Lungmo-chhe at the end of July, we had not

expected to be away for more than a week, and we had been unable to build up a reserve of food. The bulk of our supplies were still at the foot of the Lungpa Marpo glacier and every available porter was employed between this point and our forward camp in the Tatar Lungpa, seven marches away, over two high glacier passes. The baggage animals were almost valueless, but were now being employed lightly laden for the stages between the Lungmo-chhe and the camp at the head of the Sa Lungpa gorge.

A few days previously we had heard from Clifford that the seracs at the side of the Lungpa Marpo glacier had fallen and blocked the route, and that we must therefore expect further delay in receiving supplies. Cave and Clifford were indeed having the greatest difficulty in keeping us supplied. In addition to the food question our fuel had to be brought from one march down the Lungmo-chhe i.e. six marches from our forward camp.

The porters were having a very hard time of it, but they responded to every call we made. They covered the ground, crossed the glaciers, and forded the rivers generally without any supervision, often marching at night and in the early morning, because later in the day the rivers were impassable.

We were in a most critical position. Standing on the edge of a secret valley, we could see an easy way down to it, yet owing to lack of supplies it seemed that we must turn back. For four days we waited, and each day reduced our rations. The weather was mostly bad except for one day, during which I completed the work at my stations near the pass.

During this fine break, two of our Ladakhi porters, Tashi and "Munshi", volunteered to cross the pass and explore the valley beyond for fuel. They were away a little over twenty-four hours, and returned each with a load of precious fuel—burtsa and sticks. We had seen no sticks since we left Pānāmik two months before. But more important still, they brought us the totally unexpected news that the mystery river beyond the Kalmuk Lungpa flowed to the north and not to the south. They reported that it was "as broad as the Shyok at Saser". This river must therefore be the Shaksgam itself. Surely there could not be two rivers of this size. The thought of such a possibility was almost absurd.

On the 18th August, we crossed the Tatar La in a state of high excitement, cairning the route, and firmly believing that at last we were re-entering the Shaksgam. We left all our warm clothing behind and carried the lightest possible camp, our porters being almost all employed carrying supplies and survey equipment. The descent was down very steep shale to the Kalmuk Lungpa, which we reached at about 15,500 feet. The valley was enclosed, but for the first time for many a day we found plenty of grass, fuel and flowers.

The valley bottom could be followed until midday, when the

melting of the glaciers above rendered it impracticable, and we had to take to the spurs on the south side and traverse a number of tributary ravines. Our porters were very tired and moved slowly. Though the junction was only five miles from the pass in a direct line, the actual route was more than twice as far, and before they reached it they had had enough and pitched camp.

Minchinton, who had benefited by the few days' rest, sighted a herd of burrel and went in pursuit. Darkness came down before he could be found, but he was eventually spotted by means of our emergency aluminium flares and guided back to camp, tired but content. He had shot four animals.

The following day we moved on to the junction of the main river, surveying as we went, and pitched camp on the flat terrace of the right bank, about forty feet above the bed.

The last part of the Kalmuk Lungpa is quite unlike its head. It is of reddish sandstone, with a red and black clay conglomerate, probably laid down at some time by the rivers themselves, and then cut through on later rejuvenation. The flood plain widens to about three hundred yards, a short distance above the junction, and is comparatively well covered with small plants and patches of bush.

On both sides of the main valley, which I shall now call by the name we afterwards gave it, the "Zug-Shaksgam", the lower slopes were of the same red sandstone and conglomerate, but higher up, the old weathered-red limestone took its place.

The river flowed north, or a little east of north, and we soon became convinced that we were indeed back in the Shaksgam valley, and that our camp was pitched at the spot that Sir Francis Younghusband had named "Durbin Jangal". We were, in fact, so certain of this that I actually wrote a letter to the Secretary of the Royal Geographical Society and told him so.

The valley agreed in almost every particular with that of Sir Francis. Just below our camp the river-bed widened to nearly half a mile; above, it was three hundred yards wide. There were a certain number of bushes and plants, which after the barrenness we had recently encountered, suggested jungle. The valley was broad, and its slopes ended in conglomerate cliffs. Game tracks, as noted by Sir Francis, were present. The latitude of the junction was within a mile of that observed by him at Durbin Jangal with his sextant. The water in the river continued to rise until eleven o'clock at night, and then covered its bed, three hundred yards wide, thereby showing that it had a distant source and probably was fed by large glaciers.

These points agreed exactly with Sir Francis Younghusband's description of the Shaksgam. There were three doubtful details. The height of our camp was 14,170 by planetable; our aneroid made it 13,350; Sir Francis gave the height of Durbin Jangal as 12,329. We did not know by what means Sir Francis had measured

his height; if by aneroid, no reliance could be placed on it, any more than on ours; if his height had been derived by a clinometer observation, this too might be at fault, for he had already indicated that there was doubt about the identification of his peaks.

The second point was that our junction was considerably east of Durbin Jangal. But this again could easily be accounted by the same error in identification of the high peak by Sir Francis, to which he observed his azimuth, and we had been led to expect that Durbin Jangal had been shown previously too far west.

Lastly, our river was flowing a little east of north; that of Sir Francis was shown on his map flowing north-west. We had brought with us a copy of the *Proceedings of the Royal Geographical Society* for April 1892. And even this point, which might have decided us once and for all, was explained to our satisfaction. For the passage recorded here of the view from the Aghil pass runs:—“To the south-west you look up the valley”—not to the south-east. We could not therefore know whether the description was correct, or the map which had been subsequently made from the observations. It seems now almost certain that the word *south-west* is a misprint; but when everything else fitted in, or could reasonably be made to do so, the chance of a misprint did not enter our thoughts. It must be remembered that the western watershed of this valley had now been surveyed by us, and was found to be only about six miles from the ridge north of K², surveyed by the Duke of the Abruzzi from Windy Gap; that no large tributary had been recorded by Sir Francis as entering the right bank of the Shaksgam between Durbin Jangal and Kulan Jilga; and that our river was already too low to flow into the Surukwat, or into the Yārkand river upstream of Bāzār-dara.

On August 21st our men were so tired that we decided to give them a day's rest, prior to moving up to the snout of the Gasherbrum glacier. Being back in the Shaksgam again, we felt that our work was almost accomplished, and that we could finish off the survey a little more leisurely, and with more consideration for our porters. Minchinton, the Khan Sahib and I started up the valley to look for the best line.

We already knew that there was much more water here than there could have been when Sir Francis brought ponies; for he was able to keep to the river bed, while this was now impassable. The Khan Sahib and I kept as low to the river as possible, and succeeded in getting farther than did Minchinton, who took a higher route and got into difficulties. But we eventually came to a spot where we were forced down to the bed, where the river was quite unfordable, and as the river was rising rapidly, we were forced to turn back.

We now discussed the situation, and believing still that we were in the Shaksgam, and hoping that the river would subside within a day or two, we decided to explore down the valley, and

determine, if possible, the position of the Aghil pass. The weather at this time was not good for surveying, for though it was comparatively hot and fine, there was a thick haze filling the valley and obscuring the hills. Triangulation was out of the question.

On 22nd August we took a very light camp down the valley for some five miles, when we came to a point where the hills on the east closed in, and the valley began to turn westwards. The left side of the valley now opened out, but the river was a foaming torrent, filling the greater part of its bed, and we were unable to cross. The going at the foot of the hills was intensely tiring, for there were great dry streams of granite boulders to cross. These boulders lay in lines, formed fanshape from side ravines; some were huge and the troughs between them were often ten feet deep. We spent two nights here, surveying as much as we could and hoping that the river would subside. But instead, on the second night the water rose ten feet, and had not fully gone down by the morning. It was still five feet deep and with a current of about eight miles an hour, while the most hopeful line to take, making use of shallows and slack water, would have been half a mile long.

Our porters were now showing signs of permanent exhaustion, and we ourselves were suffering in various ways from strain. It would not have been fair to ask our men to cross. One man had already been nearly drowned on his way back to the depot, and now another was badly bruised by a rolling boulder in a stream. To those who do not know a mountain river in flood, I would say that it is these rolling boulders sometimes of immense size, that constitute the danger when fording, rather than the actual strength of the current.

Another porter had to be left behind on the march on the third day, suffering from fever, and fetched in later. All these men had done splendid work, and I had raised their wages as some compensation. But they were now definitely worn out, and no promise of reward had the least effect. Their enthusiasm was gone.

If we had now been satisfied, we should have come back with the story that we had regained the Shaksgam at Durbin Jangal. But there was born about this time a faint suspicion that we might be wrong. The night of the 25th was wild and windy, and snow fell right down to 14,400 feet, and we all wanted to go home.

Fortunately, the morning broke fine and crisp, and we felt encouraged to make one more attempt to reach the snout of the Gasherbrum glacier. We persuaded the men to make the effort, and the Khan Sahib started up the valley once more.

Minchinton went back one march up the Kalmuk Lungpa to try and shoot something and so ease the supply situation, and owing to the lack of men and an attack of rheumatism, from which I had been suffering for some days, I decided to take a rest, and if no news came back from the Khan Sahib, to follow him on the morrow.

The river had not subsided in the least since the 21st, but it had changed its course in its bed. The way was difficult in places, but passable beyond the spot we had reached before. About $3\frac{1}{2}$ miles above the camp a side stream entered the right bank of the Zug-Shaksgam. The tributary carried thick red water, similar to that which we had so often seen on the north of the red marble wall. It was just beyond this point that I met the Khan Sahib, returning with his men.

For about three-quarters of a mile above the "Red Stream" the main valley remained quite wide, and the river flowed in a broad flood plain, the slopes above on either side being easy. The bed then became more enclosed by steep cliffs for half a mile, beyond which the river issued from a narrow cutting between them, twenty yards wide at the top, and only five yards wide at river level. The water must have been very deep, and the cliffs were about 150 feet high above the water. Beyond this gorge the river-bed again opened out for a distance of about $1\frac{1}{4}$ miles, but the way over the cliffs was none too easy. Again the river issued from a gorge, a veritable cleft in the rock, through which the water poured. The cliffs here were only ten feet above the surface, three feet apart at the top, and about five feet apart at water-level. They almost touch in places, so that the river practically flows underground.

This extraordinary formation continued for about four hundred yards, and then widens a little. Two miles farther there is a sharp bend, the valley turns to the south-east, and is fed by glaciers; a smaller tributary joins here from the north-west. Unfortunately it was quite impossible to reach the bend, owing to a tributary gorge.

Anything more unexpected or more unlike the valley that Sir Francis ascended with ponies past the snout of the Gasherbrum glacier could not have been conceived. To my mind there is only one possible explanation. This Zug-Shaksgam must be the lower course of the Sa Lungpa, whose upper branches we had already explored. There is still just room for the river of Sir Francis between our watershed and the mountains north and east of K², though there is certainly no possibility of two more valleys of this size.

If this is the origin of the Zug-Shaksgam, where does it flow? We had already followed it down to a level which precluded any possibility of it breaking northwards to the Surukwat or Yarkand river, unless the descriptions by our predecessors of these rivers were incorrect. It must therefore enter the Shaksgam between Durbin Jangal and the foot of the Aghil pass. I have since my return had the opportunity of examining the journal of Sir Francis, and though he makes no mention of a tributary, it is quite possible that one exists. The entry for the 12th September 1889 is: "Nothing particular to note on march, and I have been very busy fixing my position accurately with regard to the main range, and have no time to write".

I have also studied the rough chalk sketch-map, which he made a few days afterwards, and this shows a tributary entering the right bank of the Shaksgam between Kulan Jilga and Durbin Jangal. I believe this will prove to be the Zug-Shaksgam.

At first the discovery that this was a "Zug" or *False Shaksgam* was a bitter disappointment. Ever since we had crossed the Aghil ranges by the Marpo La, our main object had been to reach the Shaksgam below the glacier blocks. For a time every attempt to regain the valley had been thwarted by impassable torrents or gorges. Yet at each check, which for the moment had seemed almost decisive, Hope had been revived by Fortune, and Chance had become our god.

Then we had crossed the Tatar La, and suddenly we seemed to have achieved our aim. Now came disillusionment.

Our thoughts went back to the days when we were checked by the Kyagar glacier, and we wondered whether we ought to have forced a passage. With our later knowledge of weather and river conditions, we could now assess our prospects had we done so.

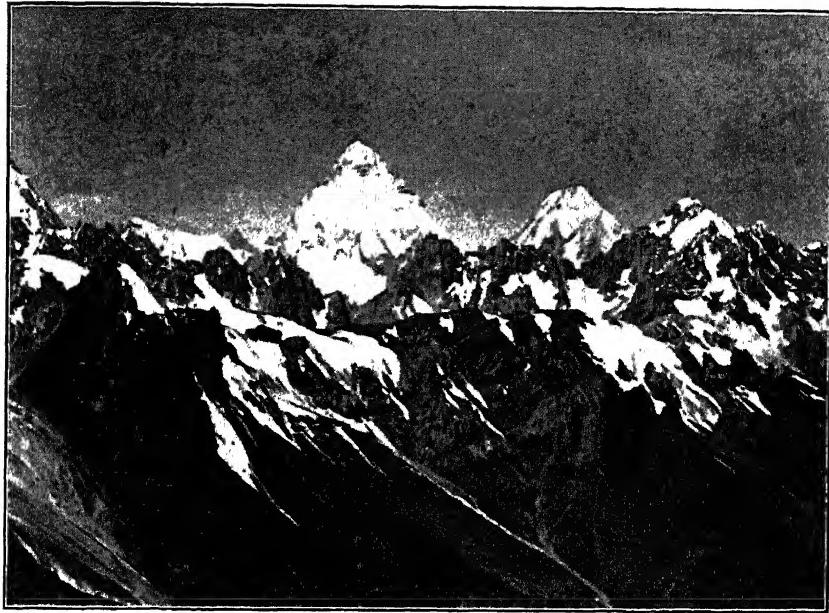
We knew now that bad weather must have prevented us from crossing with porters until the last week of July, by which time the floods had begun. In August the water in the tributaries almost stopped us, and our men had difficulty in crossing. In a river of the magnitude of the Shaksgam we must have been held up; very possibly we should have been cut off from our supplies. We should then have been driven into one of the glacier tributaries. We might have cleared up some of the points that still remain in doubt, but there would have been little hope of getting back to record the information we had gained.

Instead of this abortive programme, we had been uncovering new secrets. We had been discovering and surveying ground of the greatest geographical interest, never yet seen by man. We had discovered the unsuspected Aghil Depsang, explored the ranges of the Aghil, and mapped the unknown sources of the Yarkand river. Moreover, by passing along the Aghil, to the north of the Shaksgam, we had just as effectively proved that the river, whose source was at pass "G", was the Shaksgam and no other, as if we had followed the river down its bed. The middle course of that river, though not traversed by us, has been set in longitude, within an inappreciable margin of error. Finally we had reconnoitred across the alignment of the ancient route. In fine, we had accomplished the objects for which we had set out.

On 28th August we moved our camp back to the Tatar La, and pitched it so that our last view of the great mountains should be at dawn.

Our tent faced to the west, where was situated K². In the very early morning long before it was light, we opened it, and waited for the transformation. It was so dark that for some time

there was no difference between the night sky and the sleeping mountains. Their presence was felt, not seen. Gradually dawn came up out of the east behind us, and the west grew blacker. Then from over our zenith, the deep blue-black curtain of the night was drawn down towards the western horizon, till the shadow of the Earth reached the summit of K². Suddenly the topmost ice flushed a rosy pink. Light seemed to creep down the mountain's side, raising it from the dead. For a few minutes the giant pyramid quivered resplendent against the blackness, faintly tinted near the base, crimson at the summit. Then to the south, we watched Gasherbrum reveal her morning splendour. Mountains near the two peaks now reflected the living ice with a pale glow. And slowly, one by one, in a world of absolute stillness, they lifted their heads to the dawn.



K², 28,250 FEET, AND "STAIRCASE", 24,080 FEET, FROM THE TATAR LA.



GASHERBRUM I, 26,470 FT., FROM THE TATAR LA.

CHAPTER VI

THE RETURN

WE marched back to the depot by easy stages, for the men had much to carry and the outcoming supplies to pick up. We also wanted to give the Sa Lungpa waters a chance to subside.

We found however on 30th August that this river was still very much in flood, and the gorge through which I had forced my way for some distance early in the month was quite impracticable.

On 1st September we recrossed the Sa-Kang La and reached the depot in the Lungmo-chhe. The next three days were spent by me computing and developing photographs, while the Khan Sahib, with Minchinton and Cave, ascended the watershed north of the valley to a height of over 20,000 feet, and planetabled the ground between here and valley "J".

By the 6th a careful survey of the whole head of the valley had been completed, and we had examined all its sources. On this day the last of the Lungpa Marpo supplies were brought over the Marpo La, and we began the return journey towards the Yarkand river.

We had now to send the ponies back by the Amphitheatre and pass "G" in order to collect the rations and fodder left in the head of the Shaksgam for the journey back to Pānāmik, and to take them to the Amphitheatre, where we were due to be met on the 23rd by the caravan ordered up from Nubra. We were therefore reduced in transport to our permanent porters, and our marches had to be very short to enable the men to cover the ground twice in a day.

The weather was by no means good for surveying, and it was obvious that September sees the end of the brief autumn and the beginning of winter in these parts. The slow progress however enabled us to carry out complete reconnaissances, and the Khan Sahib was able to finish the survey of the Lungmo-chhe and the area north of it. Five points on the watershed between the two valleys had now been reached.

On the 16th September we passed the junction of the Lungmo-chhe and the Yarkand river. The latter flows in a mile-wide flood plain, and the hills on the left bank recede another mile from the bed. On the right bank the mountains rise much more steeply and

are, I think, of red sandstone; they undoubtedly belong to the same "Red Range" that stretches north-westwards, north of valley "J", as far as Bazar-dara, and was first noted by Wood.

The day before we reached the Amphitheatre we had our only serious accident on the expedition. Throughout our journey we had made a point of collecting rock specimens for examination after return to India. After arrival in camp on this day, Tilak Bahadur, one of the Gurkhas, had climbed the rocks above the river bed to reach a particular specimen, when the hillside broke away and crashed down on him. His skull was fractured, but thanks to Clifford's surgical skill he recovered, though he had to be carried for many days on an improvised stretcher by four men whom we could ill spare.

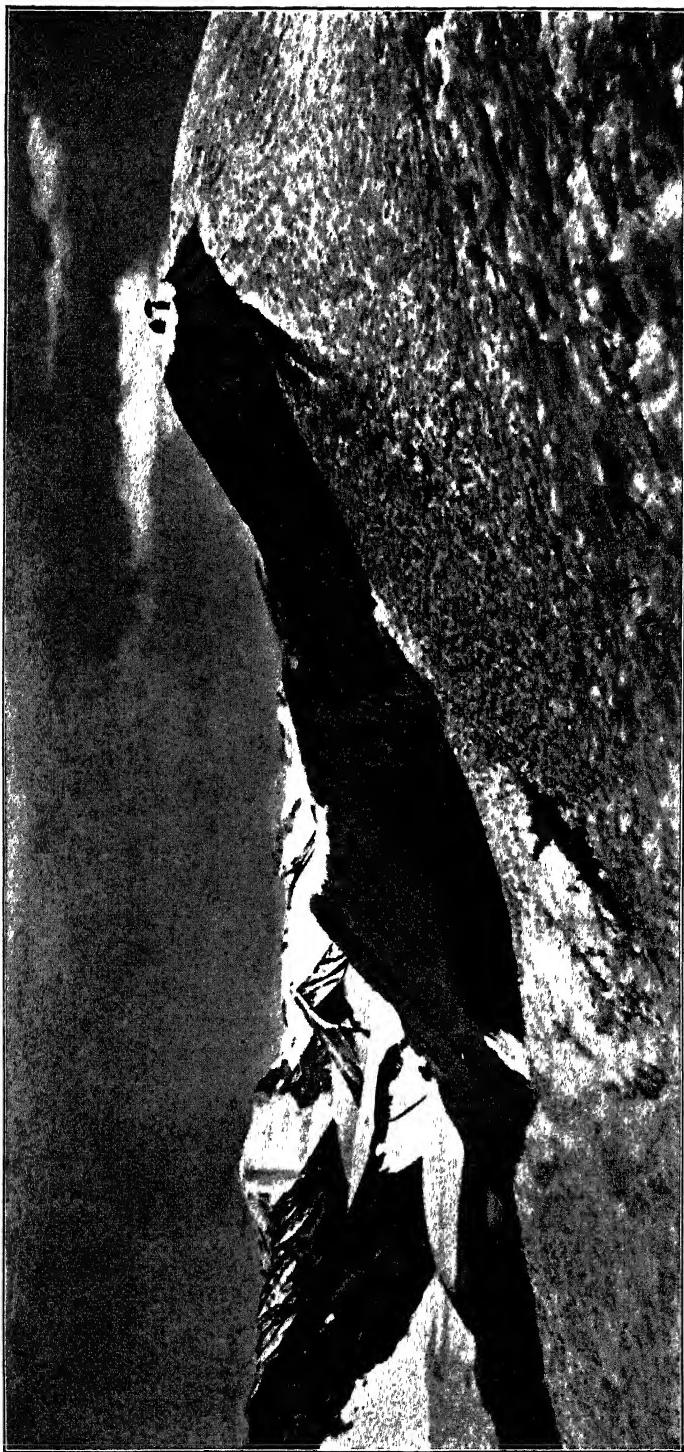
Our transport troubles were accentuated by the loss of three more baggage animals in a snow blizzard, in which they were caught on the way back to the Shaksgam. Two more ate through their picketing ropes on the night of the 22nd and were missing for forty-eight hours.

We reached the Amphitheatre on the 23rd, after halting some time on that day to observe the migrant birds on "Hayward's Lake," and found that Ali of Hondar, a pony-man who had accompanied us to the Shaksgam at the end of June, and whom we had selected to be in charge of the relief caravan, had arrived punctually the night before.

The return journey was of course a far more simple matter than the outward one. We struck the Central Asian trade-route below the Karakoram pass, beyond the Kadpa-ngonpo La, on the 26th September, and found caravans passing along it in both directions. The nights were cold and there was thick ice along the edges of the rivers in the mornings, but the weather was kind, and the Depsang and Saser La were plain sailing.

On the way back the Khan Sahib surveyed the route from the Shyok over the Saser La, and closed his survey at Pānāmik. We reached this place in the Nubra valley on 3rd October, after having been, with two brief exceptions, continuously above an altitude of 16,000 feet since we left here in June. The lower part of the Nubra valley I surveyed with the photo-theodolite.

During the expedition we took no maximum or minimum temperatures, but in the Shaksgam and Aghil areas it was not excessively cold, and I do not think we ever had more than 25° F. of frost, and rarely as much as this. Fine weather was far more usual than bad, and from Cave's detailed meteorological diary, which he kept with great regularity, it will be seen that beyond the Muztagh-Karakoram range, 70 per cent of the days were fine. It must be observed however, that on these fine days, many of which were hot in the sun, there was almost invariably a very high wind, bitterly cold, blowing from the regions of snow and ice to those that were warming up.



KHAN SAHIB AFRAZ GUL KHAN PLANETABLING AT 20,000 FEET.

Photo-engraved & printed at the offices of the Survey of India Calcutta, 1925

After midday, when these winds were generally at their worst, they must have sometimes attained a velocity of nearly a hundred miles an hour, and it is satisfactory to report that the Whymper tents supplied by Benjamin Edgington of London withstood them.

Occasionally on fine days, particularly in the Yarkand valley and in the Zug-Shaksgam, survey work was made impossible by haze, but I cannot say whether this was caused by the heat on the rocks or by loess from Central Asia. Spells of bad weather were generally heralded by a few days with cloudy skies. Were it not for these spells, it would be possible without excessive discomfort to bivouac without tents; in fact, our men sometimes preferred to do so, rather than have the labour of carrying them. In such cases, when the weather turned bad, we gave them shelter in our own. But for officers, who have survey work to do in the daytime, specimens to classify, diaries to write, observations to compute, or photographs to develop, tents are essential in such a country.

Cave, in his meteorological notes, reports that in his regular observation of cirrus between May and September, there was no single record of a high current of air from an easterly direction; the cirrus was almost universally from the west or south-west. Among other points of interest, he noted on winds, sun-halos, haze, and the succession of colours at sunrise and sunset.

Clifford was the only one of us who had difficulty in sleeping over 17,000 feet, but he is not a good sleeper at sea-level. Both the Khan Sahib and I found that altitude had a distinct tendency to make us inaccurate when computing. We completed all our computations on the expedition and sometimes had definitely to knock off this work, for the worry caused by our inaccuracies often led to headaches. On the other hand, I developed all my photographs personally on the expedition, as soon after exposure as possible, frequently at night. My results were most satisfactory, and caused no worry; there was no strain, and I went to bed comfortably tired and happy.

I write now unscientifically. From these observations and others that I have made on other occasions, I believe that at high altitudes there is at first a tendency for the mind and body to become acclimatised. With good nourishment and no cares, it might be possible to remain so, though I doubt it. Such conditions are however almost impossible. In spite of occasional differences of opinion, which are good for everyone and do no harm, we were all good friends, and remain good friends, but the mind and body become strained after long residence at high altitudes; the nerves get "ragged" and worries and anxiety reduce vitality more quickly. There is no doubt that at the end of the journey we were all suffering in various degrees from nerve strain, and both physically and mentally we all tired far more easily than when we left Pānāmik, more than three months before, on the outward journey.

The health of the whole party was good, except for a few minor troubles and the accidents I have recorded. But towards the end several men developed coughs, and Clifford's opinion was that they would not have been fit for much more work. Our baggage ponies however had a very hard time and we were much distressed at their sufferings. Of the twenty-one animals which I bought, ten died; of these, four died from altitude and lack of grass and three from exposure during a snowstorm, one from colic, one from pneumonia, and one dropped down dead with a heart attack. Two others returned from the Shaksgam unloaded and by easy stages, and would be unfit for work for several months. Four of our hundred yaks died during or after the crossing of the Khardüng pass in June, and sixteen of some two hundred hired ponies from the Nubra died from various causes, on the journey to the Shaksgam and back.

This expedition, though so completely organised and made possible by my Department, the Survey of India, and so much encouraged and assisted by the Royal Geographical Society, was the fulfilment of a long-cherished personal ambition. And this volume being the record of the expedition, it is right that I should pay a tribute to my companions who made success possible.

Minchinton's knowledge of mountaineering was a great asset. He was the hardest of all, and even when he was sick and could hardly walk, he would never be left behind. His interests in the expedition lay very largely in climbing and it was unfortunate that the exigencies of the survey prevented him from attempting any high climbs. He spent much of his spare time with the rifle and the fresh meat he obtained was of value to the expedition. His tragic death among the snows north of Dharamsala less than a year after the expedition is a great loss to the climbing world of the Himalaya.

Clifford's skill as a surgeon was happily not often required, but it is due to him that everyone came back fit and well. He was indefatigable in carrying out all the duties assigned to him. I was very sorry that he and Cave had to be left behind in the head of the Lungmo-chhe, when we went over the Sa-Kang La. Both officers however turned their time to very good account, for besides overcoming the real difficulties of keeping us supplied, they energetically carried out a complete reconnaissance of all ground within reach of the base.

Cave rarely seemed to take any rest. As soon as he reached camp, he set himself to write his meteorological diary and skin his birds. The completeness with which he did this work will be seen by the report on his collection by Mr. Hugh Whistler. He also took the keenest interest in the actual survey and in the stereographic experiments. He was the youngest member of the party, and I hope that he will lead his own expedition into the Himalaya before long.

Of Khan Sahib Afraz Gul Khan I cannot speak too highly. His energy was abnormal. He was often the first out in the morning and sat late into the night computing or working at his plane-table. He was always ready to turn his hand and his mind to any job, and he had a great knack of getting the best work out of the men. He is a beautiful surveyor, with a very accurate topographical sense.

Whatever success the expedition attained is due largely to the wholehearted way my companions set about their duties. But fundamentally, our success was due to the Ladakhi porters, who were absolutely splendid; they came of their own free will, and once we earned their confidence, they never gave us a moment's real worry. They came not only for the sake of pay, but also from a real love of adventure. It is quite impossible to overestimate their services.

The rest may be told in a few words. The Khardüng pass was easy, and we reached Leh on the 10th October. Here all claims were met and settlements made. The remaining ponies were sold and the porters paid and rewarded. A week later we left for Kashmir, and arrived in Srinagar without further incident early in November.

CHAPTER VII

GEOGRAPHICAL OBSERVATIONS AND CONCLUSIONS

In this chapter I have endeavoured to collect our geographical observations and discoveries, and to present a clearer idea of the maze of mountains and rivers than is possible in a narrative of daily travel. The preceding chapters were written almost entirely when on leave in England after the expedition, from material recorded daily in my journal, and are therefore encumbered with our doubts, perplexities, anxieties and difficulties.

During our journey back from the Zug-Shaksgam, I cleared my mind from these doubts and was able to study again the ground from a broader aspect and to check my conclusions, and this chapter was written before our arrival at Leh. After incorporating a few suggestions of Major M. L. A. Gompertz, who was in the Saser area during the summer, I submitted it to geographers and interested explorers together with my report which I gave before the Royal Geographical Society in London in January 1927. Dr. T. G. Longstaff then made some friendly suggestions which have led me to revise and treat more fully the section dealing with the Muztâgh-Karakoram, and I have added a little to the part dealing with the course of the Shaksgam, and the lie of the Urdok glacier, in view of the results obtained after working up the Stereographic Survey in Switzerland.

The Source of the Shaksgam.—Prior to the De Filippi expedition of 1913-14, the map of the region west of the Karakoram pass, with the exception of the pioneer sketches of Hayward and the rougher ones of Johnson, was almost a blank. Farther west we had the results of the explorations of Sir Francis Younghusband. But owing to the faulty alignment of the main range in the eighties, and the inadvertent omission in his report of a paragraph of his journal dealing with the source of the Shaksgam,* the upper course of that river, east of the meridian $76^{\circ} 45'$ was conjectural. Map-makers had

* In his Journal for 13 September 1889, Sir Francis wrote that the Shaksgam continues beyond the snout of the Urdok glacier "level and open with a direction 150° , while about 15 miles beyond, another valley branches off to the east with a direction 120° , and the latter must probably run very nearly up to the Karakoram pass". The former is the main valley of the Shaksgam which we photographed from the hills bordering the Kyagar glacier, while the latter probably has its source behind the "Island Ridge".



THE KYAGAR TSO, SHOWING THE GLACIER DAM ACROSS THE VALLEY.
NOTE THE ICE-BLOCKS ON THE HILLSIDES, INDICATING
THE WINTER LEVEL OF THE FROZEN LAKE.

assumed that because Sir Francis was in an intensely glaciated region, he was near the source of the river, and they had not contemplated the possibility of a wide barren valley stretching for another fifty miles.

Wood's explorations in 1914 led him to surmise that the source of the Shaksgam river was very much farther east than had been supposed, and to publish his conviction that the Yarkand tributaries, "I" and "J", had their sources in a range north of the Shaksgam. Wood also traced the alignment of a "Red Range" north of "J" valley, and showed it with a north-west to south-east alignment. Nevertheless, he did not consider that the country as a whole was sufficiently well-known for him to state his opinions definitely, and he admitted before our expedition started that he would not be in the least surprised if we found that his valley "H" broke north, cut through the Aghil range and joined the Yarkand river.

Our work confirmed Wood's surmise and pass "G" may be considered as the most distant source of the Shaksgam. The high massif carrying several peaks of 22,000 feet and some large glaciers draining into the Lungmo-chhe, "D" and the Shaksgam itself, may be considered another equally important source. But neither the glacier by pass "G", nor this massif, contributes as much water as the great ice-streams of the Muztagh-Karakoram, such as the Kyagar, the Urdok, and the Gasherbrum. Although no vast amount of water reaches the upper Shaksgam from the northern wall of its valley, the majority of the drainage of these mountains finding its way into the Shaksgam lower down by the large tributary which we discovered, yet the combined effect of the whole basin must be far greater than that of the Yarkand river above Khufelang. I am convinced, therefore, that Sir Francis was right in suggesting that the head of the Shaksgam is the true source of the whole Yarkand river.

The Kyagar Glacier.—From the junction of the two highest tributary sources, near which junction was placed our first depot, the valley of the Shaksgam trends a very little north of west. At latitude $35^{\circ}40'$, longitude $77^{\circ}10'$ approximately, the valley is blocked by the Kyagar glacier, draining from the snowy cirque of the Apsarasus group of mountains. The Kyagar glacier has a large open névé-basin lying under the wall of the Muztagh-Karakoram, divided by two large spurs into three heads. From the junction of these heads, the combined ice-stream becomes a tumbled mass of pinnacles continuing for six miles to the snout, which is crushed and contorted against the marble cliffs opposite.

As explained by Dr. Longstaff, this peculiar pinnacled ice formation is not due to any inherent quality of the ice, but is caused by the fact that the Muztagh-Karakoram range-axis constitutes a definite boundary between two different climatic regimes. The pinnacles occur in various forms and sizes on almost every glacier

of any magnitude beyond this axis, and, I believe, nowhere to the south of it. Dr. Longstaff is confident that they are caused by the incidence and interplay of radiation and evaporation, both of which depend very greatly on the humidity of the air. The axis is crossed, as I shall show later, at the Saser pass, and from that point the drier zone and the pinnacled glaciers begin.

Some attempt to describe these pinnacles has been made in Chapter II, but it is not easy. Some rise to a height of from two to three hundred feet and are of the most beautiful transparent blue ice, while others are opaque. Between them are occasional short moraine bands, and two long moraine corridors, but in the lower reaches of the glacier these are by no means continuous, owing to pressure, and they afford no passage here either up, down, or across the glacier without a very great amount of step-cutting. Many of the "leads" that I examined through my glasses ended in glacier lakes of considerable size and of the most beautiful turquoise and sapphire colouring imaginable. Near the "snout-spread" these pinnacles were distinctly dangerous, and I saw more than one fall into the lake.

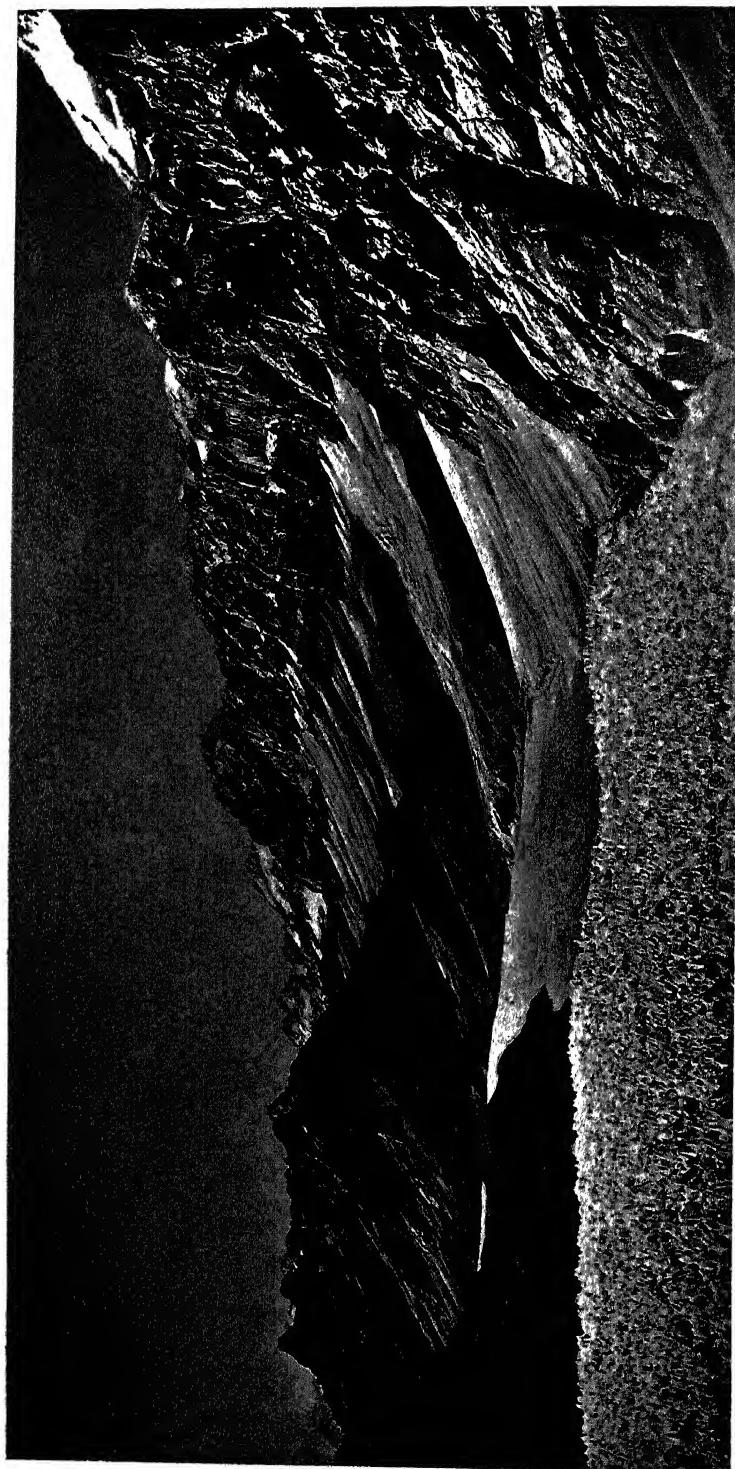
The Kyagar Lake.—The Kyagar lake, formed by the damming of the valley by the glacier is a very remarkable feature. When first discovered it still carried the remains of its winter ice. During the early part of the year very little water enters it, and percolation through the glacier dam more than counterbalances the supply. The winter ice is thus left unsupported and breaks, falling in great blocks to the hillsides and valley bottom. We were in time to see many of these lying along the slopes, giving a very good indication of the winter surface of the lake. But the level of the lake was already rising early in July, showing that percolation is really not very considerable.

Towards the end of July the lake had increased five hundred yards in length and probably fifteen feet in depth. Clifford and Cave saw it again about a month later, when it had extended a further two and a half miles, giving it a total length of somewhat over five miles.

Along the hillsides and for several miles up the valley there is a series of parallel beach-lines, scoured by the lap of waves at each high level of the lake, and appearing as though someone has been scratching contours on the slopes. These lines must give the high-water marks of the lake in different years, and are therefore a measure of the height of the glacier dam and to some extent of the fluctuation of the snout. There is no doubt that the dam has been considerably higher than it is at present, as can be seen from the beach-lines, and when it was so the snout must have turned down the valley. It has certainly worn down the cliffs opposite, carried away the debris from the mountains above, and is still polishing the marble. It is however impossible to say definitely

"ISLAND RIDGE"

"RED WALL."



Photogravure

Survey of India Office, Calcutta 1928

THE SHAKSGAM VALLEY IMMEDIATELY BELOW THE GLACIER

whether the glacier is now advancing or retreating, though over a long cycle of years it is probably diminishing in volume.*

The Shaksgam below the Kyagar Glacier.— The cliff against which the Kyagar snout impinges is the visible termination of a long range of marble, weathered red, extending in a north-west direction, and carrying peaks, some of which exceed 22,000 feet. The Shaksgam, continuing on approximately the same course as before, therefore deserts this wall, which at a distance of six miles from our stations east of the glacier is replaced by another enclosing ridge bounding the valley on the north. It appeared to be an "island ridge" and also rises to above 22,000 feet and possibly reaches 23,000. It too has a north-west to south-east trend, and between it and the marble range, which we used to refer to as the "Red Wall", a new north-west to south-east trough is disclosed. The Shaksgam river, however, now begins to bend to take a parallel alignment, and must eventually cut across the line of the "Island Ridge".

The course of the Shaksgam from the source by pass "G" was accurately surveyed by planetable as far as the beginning of the Island Ridge. From here the planetable fixings were not sufficiently far apart to give good intersections, and the work cannot be considered of the same standard of accuracy. From this point however the survey of the valley has been accurately plotted by the Wild Autograph for a further distance of seventeen miles, and the lower portions of two more glaciers entering from the south have been fixed at distances of twelve and twenty-four miles from our stations.

Before the second glacier is reached, and at a range of about twenty miles, the Shaksgam bends more sharply towards the north-west, and beyond the ridge enclosing the Urdok glacier on the east, which was surveyed also by means of the Wild instruments, the Shaksgam must lie between the ground mapped by the Duke of the Abruzzi in 1909 and that surveyed by us from the Tatar La. The gap between the two surveys is only six miles wide, and has been traversed by Sir Francis Younghusband. The latitudes of Sir Francis have never been questioned, and as the width of his valley can hardly be less than that of the Zug-Shaksgam, his course of the river can be placed on the map with very little margin for error.

The latitudes in fact do more than this, for they also enable us to plot with a very great degree of certainty the positions of the

* An interesting parallel to this lake occurred in 1926 in the upper Shyok behind the Kumdan glacier. The glacier burst late in October, and the pent-up waters swept down the Shyok, damaging the valley for three hundred miles, and destroying the suspension bridge at Tirit and the village of Deskit, near the Nubra junction. The waters must have been confined in the Shyok gorge below the junction, for they flooded up the Nubra valley to beyond Pānāmik, where some caravans were destroyed. Dr. Longstaff gives the results of his investigations concerning previous blocking of the upper Shyok valley by the Kumdan and Aktash glaciers in the *Geographical Journal*, vol. 35, 1910, p. 649.

Urdok and Gasherbrum glaciers, as will be seen from the map accompanying this volume.

The south boundary of the Shaksgam valley may be considered as the line of the great peaks — K², the Gasherbrums, Teram Kangri—but this watershed is more distant than the Red Wall on the north. The spurs projecting from the northern rim of the Rimo and from Teram Kangri have a north-west trend, and I feel certain that it will be found that the glaciers further west, *i.e.* the Urdok and the two seen by us have a similar course.

A glance at the map will show at once this curious north-west to south-east trend of the main features. Even the smaller tributaries on the north bank of the Shaksgam, east of the Kyagar snout, flow south-east and then bend right round to join the Shaksgam in a westerly direction. It appears at once as though the Shaksgam river has a course diagonally across these lines of primary elevation.

The Urdok Glacier.—Since the plotting of the map of the Shaksgam valley by the Wild Autograph, I have gone very carefully into the probable position of the Urdok glacier. I have come to the definite conclusion, from the lie of the ridges as shown by the Autograph, considered with the latitudes and account of Sir Francis Younghusband, that the Indira Col of the Workmans lies at the head of a small branch source of the Urdok glacier, and that it is shown approximately one mile too far north on the Workman's map. It is also possible that the Turkistan La is shown about the same distance too far east, on the same map.

A brief summary of my reasons is given below.

As will be seen from the map of the Shaksgam published with my paper on "The Stereographic Survey of the Shaksgam"** on which map the watershed of the Muztāgh-Karakoram range has been dotted in according to the Workman's map, we plotted a ridge with a north-north-west trend, and carrying peaks 20,250, 21,300, 20,800, and 20,200. This ridge I then believed enclosed the Urdok Glacier on the east. The alignment of this ridge if produced, meets the watershed in the vicinity of the Indira Col.

On the same map are shown the graticules of the three latitudes observed by Sir Francis Younghusband, when he was moving up the Urdok glacier, mainly by its western lateral moraine. It will be seen that the direction of the glacier, where it is west of, and probably parallel to this ridge, and between latitudes 35° 48' 05" and 35° 45' 45" is in close accord with that shown on the sketch-map of Sir Francis. The distance between the two graticules is also reasonable, three miles in each case.

On the other hand, if the dotted line of the watershed is exact, the direction of Sir Francis' route from 35° 45' 45" must bend east-south-east or almost due east, and must be almost parallel to the

* Geographical Journal, Volume 70.

watershed. This is neither apparent from his map nor likely from his account. The route between latitude $35^{\circ} 45' 45''$ and $35^{\circ} 41' 20''$ would also be at least 9 miles, which, I believe is much too far to be covered in one day on such ground, and in the bad weather experienced by Sir Francis.

The glacier, whose lower reach is shown on my Autograph map in longitude $76^{\circ} 49'$, east of the ridge mentioned above, is ruled out of the discussion by the fact that it joins the main valley south of latitude $35^{\circ} 48' 5''$, which was observed by Sir Francis at the end of his first march up the Urdok.

Now if we assume that the Indira col is south of the last latitude taken by Sir Francis, *viz.* $35^{\circ} 41' 20''$, we can fit in the head of the Urdok glacier to suit all considerations. It must be remembered that the upper portion of the Siachen glacier basin was not surveyed by Grant Peterkin, nor by anyone else. I have in my possession a note by Peterkin that the Workman's map here is unreliable, being sketched from photographs. Anyone who knows the extreme difficulty of judging distance when walking over soft snow at high elevations, will readily allow that a mile error in the estimation of a distance on the ground or from a photograph is very easy to make.

If we accept this position of the Indira col, then "the large glacier flowing north-north-east", which was seen from it, is the Urdok. The "long splintered rock-ridge" is the continuation of the ridge surveyed by us and mentioned above.[†] One source lay about 5,000 feet below the Indira col, at an altitude of about 15,500 feet.[‡] while to the west, on the eastern flanks of Gasherbrum I is another.

The "wide-trunk" glacier, seen from the Turkistān La, and joined by a short crevassed glacier below the saddle, is probably the glacier whose lower reach was mapped by the Autograph in longitude $76^{\circ} 49'$.[§] The "grand group of peaks" to the south-east is, I believe, none other than the Teram Kangri group, looming up through the clouds, and appearing closer than they actually were.

The high ridge containing the three lesser Gasherbrum peaks throws a long spur northwards. We mapped and contoured this with the Autograph for a distance of four miles. I have identified points on it in the stereoscope with points in the photograph taken by Sella and shown as Panorama F in De Filippi's book of the

[†] Sir Francis Younghusband describes this ridge thus: (Proc. R. G. S. Vol. 14 p. 212) "the mountains on either side of the valley (*i.e.* the Urdok), especially on the eastern side, are extremely rugged and precipitous, affording little or no resting place for the snow, which drains off immediately into the glacier below".

[‡] Workman, whose hypsometric height of Indira Col was 20,860, reported the glacier below to be about 5,000 or 6,000 feet below. The height of Sir Francis Younghusband's last camp on the glacier was recorded by him as 15,855.

[§] This glacier was seen by Sir Francis, *vide* page 210 Proc. R. G. S. Vol. 14. "Another glacier could be seen to the south."

Abruzzi expedition. This is the ridge that divides the Urdok glacier from the glacier which drains the area between the Gasherbrums and Broad Peak, and which was seen by the Duke of the Abruzzi's party from the Sella Pass.

Sir Francis mentions three branch glaciers entering the Urdok from the west. One of these drains the southern slopes of Gasherbrum ; the second drains from between Gasherbrum I and Gasherbrum II, III, IV. The head of a third was plotted by us immediately north of Gasherbrum II. We may compare these western glaciers of the Urdok, and its precipitous eastern wall, with those of the Kyagar glacier which we surveyed accurately on the 1 : 50,000 scale in the Autograph.||

There may be an eastern head of the Urdok swinging round from the Turkistān La and separated from the Indira source by the "triangular massif" mentioned by the Workmans, in the same way that the two promontories, or "triangular massifs", of the Apsarasus divide the head basin of the Kyagar. But if this is so I am inclined to believe that the Workman's map shows the Turkistān La too far east by at least a mile. But this last depression cannot possibly be the "Younghusband saddle", for it faces east, and would not be seen until the triangular massif had been rounded by Sir Francis.

I am convinced that Sir Francis was ascending the ice slope at the northern foot of the Indira col, when he was finally checked by a crevasse.

The Aghil Mountains.—When my party transferred its base to the head of the Lungmo-chhe, the watershed was crossed at the Marpo La. To the north-west stretched a group of peaks over 21,000 feet in altitude, and these were again seen later and surveyed from the head of the Sa-Kang La glaciers. This group, also of marble, with some red boulder conglomerate, extends north-west and borders the Sa Lungpa valley on its south-west side. The axis is parallel to that of the Shaksgam "Red Wall", but separated from it by at least one subsidiary glacial trough. The two branches of the Sa Lungpa, from south-east and from north-west, meet in the north-east boundary of the range, cut through it in a south-westerly direction, collecting the drainage of the glacial troughs, and as far as we could see from hills at the head of the gorge, the whole appears to be thrust against the Red Wall and forced north-west. It seems highly probable that for some distance it is only separated from the Shaksgam by the Red Wall, but that after cutting a tortuous passage through the heart of the Aghil, it eventually becomes the Zug-Shaksgam, which we explored from the Kalmuk Lungpa. If this is so, it must again cut back through the Aghil mountains.

|| See the reduced map of the Kyagar glacier on the same sheet accompanying my paper in the Geographical Journal.

This section of the Aghil Mountains may therefore be described briefly as a chain comprising three and possibly four axes of limestone, parallel to each other and with approximately a north-west to south-east trend. It carries a number of peaks above 22,000 feet and one at least over 23,000 feet.

The Head of the Lungmo-chhe and the Sa Lungpa.—The troughs of the Sa Lungpa and of the northern source of the Lungmo-chhe also lie parallel to the prevailing trend, and this trend is now seen to conform to the strike of the rocks, which are stratified and yielded fossils, probably of Jurassic age. But the drainage is far less regular, for the Lungmo-chhe then drains across the strike into the Yarkand river, and thence past Khufelang, while the Sa Lungpa cuts a passage into the Aghil mountains as described above. The Sa Lungpa trough is also very different from that of the Lungmo-chhe in other respects. The latter is conspicuously fertile for this part of the world, and contains plenty of grass and burtsa, while the Sa Lungpa goes to the other extreme, and is the acme of desolation.

The north-western of the two saddle glaciers of the Sa-Kang La extends right across the valley, definitely blocking it and forming the south-east source of the Sa Lungpa. The north-west branch of this river has two sources: one from a glacier on a ridge of the Aghil range, and the other draining through a gorge cut by drainage from the southern point of the Aghil Depsang. The trough of the Sa Lungpa is continued beyond the glacier source by the deep eroded valley of the Kalmuk Lungpa.

The country north of the Lungmo-chhe and the Sa Lungpa is much more worn than that to the south, being of a softer limestone, black micaceous sandstone and grit, and very much crushed shale. But here too there are traces of the same north-west to south-east trend. The ranges are not so continuous, and are frequently cut by gorges. The barren country between the Lungmo-chhe and valley "J" was found, contrary to expectations, to drain into the latter through the gorge followed by Clifford and Cave. This country is almost as barren as the Sa Lungpa, and probably more so than valley "J", for burtsa was found in a side valley close to the latter.

The Aghil Depsang.—It has been recorded with what surprise my party discovered the Aghil Depsang. After toiling along the barren Sa Lungpa gorges, trying to find an outlet to the Shaksgam, being saturated with ideas of the general trend of the country, nothing was more unexpected than a high open plateau. The greater part of this plateau drains into valley "J", giving it a very large basin. The strike of all outcrops of rock that we measured followed a south-east to north-west trend, but today the ranges across the plateau, if they ever existed, have been completely worn down, and it seems to me that they can never have been of very

great significance.

The Aghil Depsang is about seven miles from north to south, and about five from east to west; it is therefore somewhat smaller than the Depsang south of the Karakoram pass. But the similarity between the two is most remarkable. Both have the same broken stony black surface, with "squelchy" river-beds; both have isolated hills of black debris and disintegrated rock, limestone breccia and sandstone; the drainage of both is from their western margins across the plains, and not from a central watershed. Both give a scanty grass, apparently identical, but no burtsa; for both are at the same altitude, 17,500 feet above the sea. Both can be very hot in summer sunshine or perishingly cold with bitter winds drawn to the warming area from regions of ice; and to both the female antelope brings her young, away from wolves and other molestation. To the west of each there is a range, the features of which are remarkably alike.

But there is one difference: in the region of the Depsang, south of the Karakoram pass, the Kizil Langar has captured the drainage of the glaciers; while at present, the Sa Lungpa has not yet cut back far enough to take much of the waters of the Aghil Depsang. The difference is, I believe, due to the later retention of an icecap on the latter, remains of which are to be seen in the form of the "saddle" and "crawler" glaciers stretching on to the plateau. Yet these last appeared to me to be retreating, for young gorges are now being cut in the soft rock by the glacier waters, and it may not be long, geologically speaking, before the last dissimilarity vanishes.

The "Red Range".—Before passing to a consideration of the Karakoram as a whole, it appears desirable to mention the "Red Range". Colonel Wood recorded its existence north of valley "J", and stated that he observed it extending for some distance on both sides of Yarkand river. For some distance he surveyed it. We never had an opportunity of visiting it, but it was a conspicuous feature from many of our stations. It appeared to us to extend as far as Bazar-dara, and in a south-westerly direction we observed it on both sides of the Yarkand river, making roughly in the direction of Balti Brangsa. This is of interest, for I received a letter from Colonel Wood during my journey back, in which he wrote:

"The Red Range is, I feel pretty sure, a watershed, and I think that it and the range just west of the Yarkand river and continuing south-east are one. The Yarkand river cuts through it, just north of "J", and the other branch of the Yarkand river, which starts from the Karakoram pass and along which runs the trade-route, cuts through it between Balti Brangsa and Baksam Bulak...."

The above was written quite independently of our observations, which are however, in entire agreement with it. I am uncertain how far to the south-east this range extends, for no modern survey

has been made beyond longitude $78^{\circ} 15'$. Nevertheless, on our return journey across the Depsang plains I could see distinct traces of what appeared to be the same red range north-east of the Chipchap.

After considering this "Red Range" in connection with the other ranges north of the Shaksgam, as far as the Red Wall, it is impossible not to be impressed by the essential unity of the whole group, for which I propose the name *Aghil-Karakoram* (see below).

Extension of the Aghil-Karakoram.—Having sought out and established the general trend and structure of the ranges and ridges in the area of our survey, it was natural to try and follow their extensions in both directions. North-west of us this was not easy, for the country was cut across by the Zug-Shaksgam, which held us up at the end of August. But I am of opinion—and this is rather in the nature of a guess—that either the Shaksgam "Red Wall" or the "Island Ridge", may be originally an extension of the north-west to south-east range seen by and photo-surveyed by the Duke of the Abruzzi's party from "Windy Gap". If this is so, the main Shaksgam cuts through these outer walls. Whether it penetrates the whole of the crystalline core of the outer Aghil and passes between this and the stratified ranges further north can only be decided by further exploration. If it does, and from the sketches of Sir Francis this appears most probable, then the course after the westward bend by Kulan Jilga will be found to lie in a continuation of the Sa Lungpa—Kalmuk Lungpa trough.

A long way further north-west, in upper Hunza and on the Pâmirs, it is interesting to record that the rocks are very similar to those of the Aghil ranges. This fact of course is no indication that the ranges were elevated at the same period, but it very possibly means that the sediments composing their rocks were deposited beneath the sea at approximately the same time. Though I believe that no fossils have been found in upper Hunza or the Pâmirs,—certainly we found none when surveying there in 1913,—which makes it difficult to determine the age of the sediments, it is an interesting fact that Sir Henry Hayden's belief that the "Pamir Limestone" is roughly of Jurassic age is borne out by our discovery of Jurassic fossils among the Aghil rocks.

It was the south-eastern prolongation of the Aghil mountains that afforded the most interesting results. The Shaksgam "Red Wall" is almost certainly continued along the southern watershed of valley "H", to pass "G", and I should not hesitate to place its continuation along the northern watershed of the Rimo glacier. There is a marked geographical and structural similarity between the Depsang peaks and those on the south-west border of the Sa Lungpa, and the Burtsa river cuts a gorge through the range above Murgo, remarkably similar to the gorge of the Sa Lungpa, which checked us early in August. The walls of the two gorges appeared to me to be of the same rock, and the towering ice-capped peaks

have much the same appearance. The Sa Lungpa gorge is certainly much narrower and more difficult, but this would be explained by the smaller rainfall and consequently slower rate of erosion. In 1909, when in the neighbourhood of the Chong Kumdan glacier in the upper Shyok, Dr. Longstaff observed that "the rocks were of limestone and grey calcite, weathering to a beautiful red, which was very remarkable on the high peaks to the east across the river".

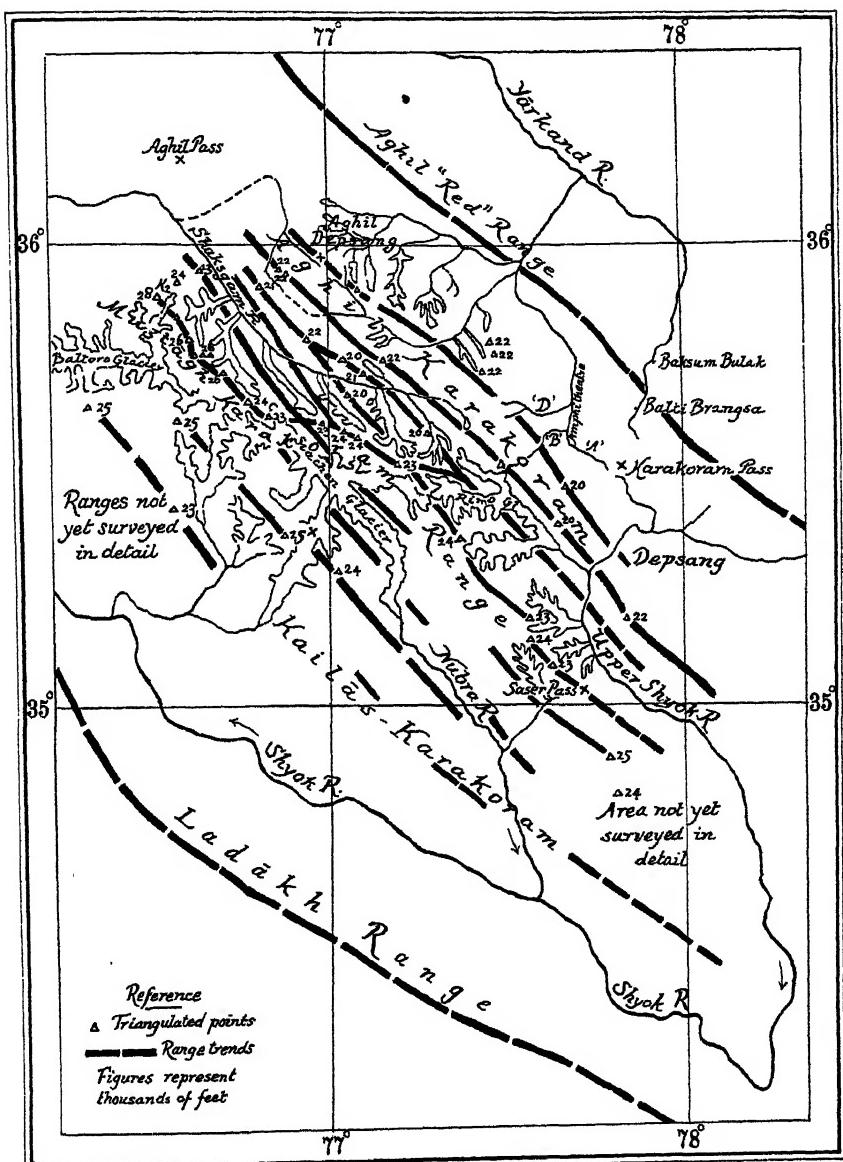
I am personally convinced that the Aghil chain as a whole, and probably its component ridges as well, can be traced south-eastwards from longitude 77°, north of the Rimo, through the Depsang peaks and plateau to the gorge above Murgo, and possibly beyond it. The similarity of the two Depsangs and the discovery of marine fossils along a line parallel to the trend, though perhaps no definite argument in themselves, are new facts entirely favourable to this point of view*.

The Muztāgh-Karakoram Range.—The great range of snowy peaks which include K², the Gasherbrums, and Teram Kangri, has for some years been known to European geographers as the "Karakoram". This name, as Wood rightly points out, is given by the Central Asian traders to the pass alone, and not to the mountains. Wood surmises that it was Hayward who first suggested applying the name to the mountains, and that it was given some sixty or seventy years ago, probably as a regional name, very much like the Himalaya.

Hayward certainly used the name "Karakoram", but he also employed the other, Muztāgh, as well, as did Sir Francis Younghusband. According to Sir Sidney Burrard, Moorcroft was the first Western geographer to apply the name "Karakoram" to the great range which separates the Indus and Tarim basins, and this was over a hundred years ago, in the youth of our knowledge. My own belief, after studying Hayward's account, is that Hayward meant to use the name "Karakoram", *Black Gravel*, only for the unexplored system of mountains west of the Karakoram pass, while "Muztāgh" was reserved in his mind for the barrier of ice-mountains, as it is today applied by the traders.

It is first of all Moorcroft's misapprehension, and then a misunderstanding of Hayward's intention, and of the observations of Montgomerie, of the Survey of India, that has led European geographers to use the term "Karakoram range" as it is at present applied. Montgomerie used the symbol "K" for all the peaks he measured which appeared in the direction of Moorcroft's Karakoram, and at the station of Haramukh, near the Wular lake in

* I have unfortunately been unable to examine the results of the De Filippi expedition of 1913-14 in this respect, as up to the present no British publisher has been found with sufficient enterprise to publish the English version which has been written by Sir Filippo.



THE RANGES OF THE KARAKORAM HIMĀLAYA

Scale of Miles
 Miles 10 0 10 20 30 40 Miles

Kashmir, he first observed K², entering it as such in his angle book.*

I do not think that Montgomerie believed for a moment that the peaks he labelled "K" were all on a single range, and the topographical surveys of Godwin Austen soon proved that they were not, and that K¹ and K⁶ lay on a southern alignment. But I certainly believe that the naming of K² has influenced geographers in retaining the name "Karakoram" for the single range.

One of the direct results, I am sure, of denoting the line of the great peaks by this name has been to insist that the Karakoram pass must lie on it. The "Karakoram Range" has been made to bend out of its normal alignment, almost to due east, in order to include the pass. It has been allowed to cut across the mountains that I have shown above as belonging to the Aghil chain; and the great divide between the Nubra and the upper Shyok, which is even yet only barely reconnoitred, has been submerged in geographical insignificance, though it carries four triangulated peaks over 24,000 feet, one of which attains 25,000 feet.†

Our conception of the Aghil chain must necessarily change all this. I am unfortunately not acquainted with the southern aspects of the great peaks of this range from close quarters, but they have been amply described by Sir Martin Conway, Sir Filippo De Filippi, Dr. Longstaff, and the Workmans. The great peaks of the Nubra-Shyok watershed, imperfectly surveyed as they are, exhibit very marked points of similarity to K², the "Broad Peak", and Teram Kangri. On the chain described above as the Aghil there are no peaks attaining this altitude, or bearing the same visible points of

* It may be of interest to state that Montgomerie's entries of the "Karakoram" peaks in his angle book for the station of Haramukh, together with their present heights and names, accepted by the Survey of India, are as follows:—

| | | |
|-----------------------|-----------------|-------------|
| K ¹ (west) | Masherbrum west | 25,610 feet |
| K ¹ (east) | Masherbrum east | 25,660 |
| K ² | K ² | 28,250 |
| K ³ | Gasherbrum IV | 26,000 |
| K ^{3a} | Gasherbrum III | 26,090 |
| K ⁴ | Gasherbrum II | 26,360 |
| K ⁵ | Gasherbrum I | 26,470 |
| K ⁶ | Karakoram No. 8 | 25,110 |

The "Broad Peak" of Sir Martin Conway, as far as I remember, is hidden behind the Gasherbrums in the view from Haramukh. It was therefore not observed by Montgomerie. The height, 27,130 feet, obtained by the Duke of the Abruzzi is undoubtedly too great, and we found, after carefully setting our stereographic photographs in the Autograph, and controlling them on the triangulated heights of K² and the Gasherbrums, that its altitude is 26,400 feet, with a probable error of 50 feet, relative to K².

In the above table, Gasherbrum I is the "Hidden Peak", and Karakoram No. 8 is the "Bride Peak" of subsequent travellers.

† Burrard implies that the Nubra and upper Shyok *both* drain from the north of the Karakoram range. But he was uncertain owing to lack of data, and he wrote before the discoveries of Longstaff. Consequently the name of the range has not been shown on maps according to Burrard's views. Wauhope tentatively showed the Karakoram along the whole of the Nubra-Shyok divide, thereby excluding the Karakoram pass; the watershed south of the Saser pass is as yet insufficiently surveyed to say whether he was correct, (see below).

similarity, such as the association of a granite core or base with crystalline limestone. Godwin Austen has suggested that this association of granite and limestone occurs in K²; De Filippi has reported the same in the case of "Broad Peak", the Gasherbrums and "Golden Throne"; and both Dr. Longstaff and the Workmans have recorded limestone near the head of the Siachen glacier. We observed the same in the neighbourhood of the Saser pass—a fundamental basis of granite, but associated with limestone.

From a glance at the map as a whole, in spite of its incompleteness, it is apparent that a very high watershed between the upper Shyok and the Nubra extends from the Saser pass northwards to the head of the Rimo glacier and thence to Teram Kangri. From mountains near the Saser pass Major M. L. A. Gompertz formed the same opinion independently and Dr. Longstaff agrees that this watershed is the main range.

There is one further argument, if such is needed, small in itself, but adding weight to the rest. As stated above, beyond the Saser pass there is a change in climatic regime, which extends north of the alignment of the range as far west at least as the Aghil Depsang.

We have in fact a new country, more Tibetan in aspect from every point of view. Everything is different: The rocks have become sedimentary, the climate has become dry, the glaciers are pinnacled; the Tibetan antelope and the Tibetan snow-cock are present, while the ibex and the Himalayan snow-cock are no longer seen.

It is impossible to say at present, how far the Nubra-Shyok watershed can be considered an extension of the Muztagh-Karakoram. My belief is that the upper Shyok cuts through it below Katakklik; but a modern survey of the whole watershed is necessary before this point can be settled.

The Kailas-Karakoram.—In the note that Dr. Longstaff wrote in the *Geographical Journal* as an appendix to the discussion on my paper, he called attention to the second great mountain chain south of the range discussed above, and bearing the peaks Rakaposhi, Mango Gusor, Masherbrum, and the Bilafond (Saltoro) peaks. The same north-western to south-eastern trend of the topographical features is duplicated, and he stressed the essential unity of this range with the Muztagh-Karakoram. This is the range for which Sir Sidney Burrard suggested the name "Kailas" in 1906.

Nomenclature of Ranges.—At that time the nomenclature of the ranges and their probable alignment were based on the old reconnaissance maps of Godwin Austen and his colleagues. Colonel Godwin Austen himself told me that in 1861 they were expressly instructed not to waste time over the survey of barren ranges above 15,000 feet. Since those days we have had the detailed surveys of Sir Martin Conway, the Duke of the Abruzzi, Dr Longstaff, the

Workmans, Sir Filippo De Filippi, and Colonel Wood.

The discoveries of Dr Longstaff concerning the Muztāgh-Karakoram axis north of the Siachen glacier, in particular, emphasise the parallelism and essential unity of this range with the Kailas-Karakoram range to the south of it. I claim a similar unity and parallelism for the Aghil ranges beyond.

It seems that the time has come when we should reconsider our nomenclature, bearing in mind the general view that it is not "advisable to abandon a name after it has been for many years in common use upon maps".

The name *Karakoram* has not been universally applied to the Muztāgh-Karakoram. In the last thirty years I find, for practically the same region, the names, Eastern Karakoram, Western Karakoram, Central Karakoram, Karakoram, and even Muztāgh. The last still means the ice-mountains, and therefore this Muztāgh-Karakoram range, to the traders.

The name *Kailas*, suggested by Burrard, has hardly become identified with the range to the south, and Longstaff, who probably knows the range better than anyone definitely considers the name unsuitable; he stresses its unity with the range to its north rather than with the Kailas mountain many miles to the south-east.

The name *Aghil* has only been written over a system of almost unknown mountains, whose alignment was conjectural till our expedition.

I venture to suggest, and Dr Longstaff agrees, that the whole mountain complex between the valleys of the Shyok and Indus on the east and south and south-west, the Hunza river on the west, and probably the Raskam-Yārkand river on the north, should be called by the regional name "Karakoram-Himalaya". Perhaps the northern boundary need not yet be settled. This regional name would then include the "black gravel" area of the Turki traders, and an "abode of snow" well within Indian borders. It would include all the "Ks" of Montgomerie, and all the Karakorams, Eastern, Western, and Central, of subsequent travellers. This use of the word "Karakoram" binds the individual ranges together in lateral sense and the essential unity that Longstaff emphasises is made clear.

Furthermore, I suggest that this Karakoram-Himalaya region be divided into the Kailas-Karakoram, the Muztāgh-Karakoram, and the Aghil-Karakoram. In the first, the southern range, called by Burrard the "Kailas", we have his suggestion of the Kailas alignment. In the second, the great white ice-mountains, Muztāgh becomes the defining word, and the best known Muztāgh passes now lie on it. And in the third, we have the Aghil pass and the Karakoram pass both on the Aghil-Karakoram range.

CHAPTER VIII

THE SURVEY

THE map of the area explored by us is drawn mainly from the planetable survey of Khan Sabib Afraz Gul Khan, of the Survey of India, and is based on triangulation executed by myself and adjusted and supplemented by the Stereographic Survey carried out by me with the Wild Photo-theodolite. I will therefore divide this chapter into three parts, viz: (1) triangulation, (2) planetable survey, and (3) stereographic survey. Since this was the first time that stereographic survey has been applied to geographical exploration, I may perhaps be excused for dealing somewhat more fully with the third section than with the first two.

Triangulation.—A certain number of peaks had been fixed by previous triangulators on the borders of our area. A few of these peaks were well fixed, particularly for position, from stations of the geodetic and secondary triangulation of Kashmir. Among these may be included K³ and the four Gasherbrums, first triangulated in the 'fifties of last century by Montgomerie. Teram Kangri, discovered by Dr Longstaff in 1909, was fixed by Mr V. D. B. Collins in 1911 by supplementary triangulation emanating from the secondary triangulation of Ladakh, and was expected to be of a slightly lower order of accuracy owing to the fewer stations of observation, and the less well proportioned figures.

Colonel Wood's triangulation, executed on the De Filippi expedition, 1914, comes next in order of accuracy. It was based on stations resected from unmarked triangulated peaks of the Survey of India; and his fixed points were also unmarked in any way.

Grant Peterkin's triangulation of the Siachen glacier and Commander Alessio's traverse work on the Rimo glacier were also based by resection on peaks fixed by the Great Trigonometrical Survey of India, and these supplied a certain number of points along the Muztagh-Karakoram range and on the Rimo-Yarkand river watershed. I have no doubt that, considering the difficult nature of the country, these triangulations are all sufficiently accurate *inter se*, for the purposes of the topography. But again it must be remembered that the observations were made to unmarked peaks, the intersections were in many instances very acute, and without being in any way critical, I may say that the positions of the points are liable to be as much as 100 feet in error in the direction

of the ray of observation. Such an error is unplotable on the scale of the topographical maps made by these explorers, and for all practical purposes those maps may be taken as correct, where based on such triangulation.

Our own approach to the Shaksgam lay between the points fixed by Wood and Alessio, and these points were unconnected by direct triangulation. We therefore experienced a little difficulty at first in locating the exact part of the summits observed by them. Their points were considerably higher than their stations of observation and than our stations, and this fact led to uncertainty. From our station on the high ridge south of our Depot Camp we were however able to make a fair fixing by resection from two of the peaks fixed by Wood, (Peaks 16¹ and 30, 23,720 and 21,410 ft.), and two peaks fixed by Alessio, (20r and 24r, 21,650 and 20,512 ft.). The mean position of our station worked out at latitude 35°38'44"9", longitude 77°18'16"4".

Our second station, on the ridge north of our depot, was resected from Gasherbrum I and II, Peak 16¹, and the first station.

Neither of these two fixings were good enough to justify an extension by means of a regular series, though they were good enough for immediate topographical purposes, and it was not till we reached the ridge on the east of the Kyagar glacier and could observe to the Teram Kangri peaks as well as Gasherbrum I and K², that we were absolutely satisfied.

Our forward observations from here were made in the hope that we should later be able to get good cross rays. But owing to the course of the expedition and the impossibility of making any station on the main Aghil range, we were unable to observe such rays. The distant forward observations with the theodolite from the Kyagar stations intersected at very acute angles and the positions of points so found are therefore unreliable in longitude. When making the map afterwards with the Autograph, I found that the more distant these points, the more unreliable they were, and I concluded that the Autograph when "set" on K² and the Gasherbrums, gave better and more consistent results (see below).

In the Sa Lungpa, where I resected my position solely from Wood's points and at the Tatar La, where I was able to make use of G.T. points, my position worked out quite satisfactorily, and the planetable connection between the two areas required practically no adjustment.

I have given at the commencement of the chapter my opinion of the order of accuracy of previous triangulation. I must conclude by admitting that any error generated in the earlier work, owing to the uncertainty of the exact points observed and to the acute angles of intersection, must have been augmented in my own work, which is therefore of a lower order of accuracy. And I would urge that all future triangulation should be brought if possible from the

geodetic chain in Hunza or on the Pāmirs, where the observations were all made to signals. While the triangulation in the Aghil and Shaksgam regions has been sufficient to control the topographical work here, I do not consider that it is accurate enough, with the exception perhaps of Wood's work in the main Yārkand valley, for further extension.

I may add that all our observations were computed during the expedition by the Khan Sahib and myself.

The Planetable Survey.— The planetable survey, on the scale of 2 miles to one inch was carried out entirely by the Khan Sahib. He commenced work at pass "G", which was fixed by Wood in 1914, and carried a planetable traverse down valley "H", the head branch of the Shaksgam. As soon as our first two triangulation stations were computed the whole of this first portion was adjusted. Sufficient control points having been supplied to him he completed the survey of the upper Shaksgam and the Kyagar glacier by the middle of July.

His stations on the Kyagar ridge, through no fault of his, were however too close together for good intersections far down the Shaksgam valley, and his map here was consequently more generalised. His map of this part of the Shaksgam and of the Kyagar glacier has been superseded by the stereographic survey (see below).

Wood's $\frac{1}{4}$ -inch map of the Lungmo-chhe, with its side tributaries and glaciers, has been revised on the same scale, 2 miles to one inch, by the Khan Sahib. Wood was only in the valley for two or three days, and his triangulated points were not then available to his surveyor, Shib Lal. The Khan Sahib benefited by having Wood's fixed points already plotted on his planetable, and was able to produce a very detailed map of the whole of this region.

He also surveyed accurately the upper Sa Lungpa branches and the Aghil Depsang, this survey being closed on Wood's furthest station up valley "J". The region between the Lungmo-chhe and valley "J" was sketched from several stations ascended on the watershed north of the former, the actual course of the bottom of the tributary to "J", north of the Dizma La, (which could not be seen from the watershed) having already been explored on foot by Cave and Clifford.

The region immediately north of the Aghil Depsang is complicated. I am uncertain, as is the Khan Sahib, where the northernmost glacier drains. I am inclined to think that it flows more to the south-east than shown by the Khan Sahib, and that it probably joins valley "J" immediately north of Wood's station, '18250'.

The course of the Zug-Shaksgam and neighbouring mountains, between latitudes $35^{\circ}55'$ and $36^{\circ}09'$ may be accepted as accurate. From the furthest point reached by us, the river appears to bend west, and probably then swings more to the south-west. The lowest point reached in this direction was about 13,500 feet, and if the

ground in the neighbourhood of the Surukwat, sketched from afar by the De Filippi expedition, is even approximately correct, the Zug-Shaksgam cannot flow into this river nor into the Yārkand river above Bāzār Dara. The middle course of the Sa Lungpa, between longitudes $76^{\circ}50'$ and $77^{\circ}02'$ is guesswork, based on the tops of ridges which were fixed, and on probability. The actual course of this section was not explored. I believe it to be an impenetrable gorge except perhaps when frozen over in mid-winter.

For details of the compilation of the middle Shaksgam and the northern glaciers of the Muztāgh-Karakoram, see pages 65-68.

In the whole of this planetable survey, the Khan Sahib displayed the greatest energy and zeal. After a long day's work on the mountains, he would work late into the night inking up his survey. He was tireless, his topographical sense was amazing, and his draftmanship beautiful and accurate.

The Stereographic Survey.—At no period of my preparations nor during the expedition did I intend to make a complete map of the country by stereographic methods. I well knew that the difficulties of transport and uncertainties of travel, together with the many other duties I had taken upon myself, would prevent the possibility of a proper reconnaissance, such as is desirable for the selection of stereo-photogrammetric stations. I had also no technical survey assistant other than the Khan Sahib, whose time was much too occupied to be of much assistance.

For those who have had no experience of stereo-photographic survey, I may very briefly describe the method as follows. Two photographs of approximately the same country are taken from points whose positions and heights are known and whose distance apart is measured. The azimuth of the camera axis and its tilt at each station are recorded. With these data, observed immediately prior to the taking of the photographs, it is possible to set up the negatives in a machine, in the same relative positions to each other as they occupied at the time of exposure. By the aid of stereoscopy, it is then possible to plot automatically the detail and contours of the ground viewed in relief.

This method has been gradually developed in recent years, mostly on the continent, mainly for large-scale engineering projects. For geographical purposes the method was entirely experimental, and no automatic plotter had ever been used for drawing maps on so small a scale as 1:100,000. Nor had the method ever been used for plotting topography at such great distances as I contemplated.

The field outfit, consisting of the Wild Photo-theodolite with tripods, targets, subtense bar, and other accessories, was purchased by the Council of the Royal Geographical Society after exhaustive enquiries to ascertain which of the various models on the market was most up to date. Chemicals, developing outfit, Imperial Special

Process plates etc., were purchased for the Survey of India by Mr. A. R. Hinks, the Secretary of the Society. This field equipment is designed for use with the Wild Autograph, which has been specially constructed to plot the photographic pairs rapidly and accurately.

I will make three groups of our experiments. The first includes a number of photographs taken within the area of the planetable survey, in order to form a comparison between the two methods. The second comprises a number of photographs taken from stations at the edges of our planetable survey, in order to test the value of the method for long-distance reconnaissance survey. And the third is a small series of photographs taken on the line of march through Nubra in Ladakh, without any control points identified for certain, to test the limitations of the method for the revision of old maps.

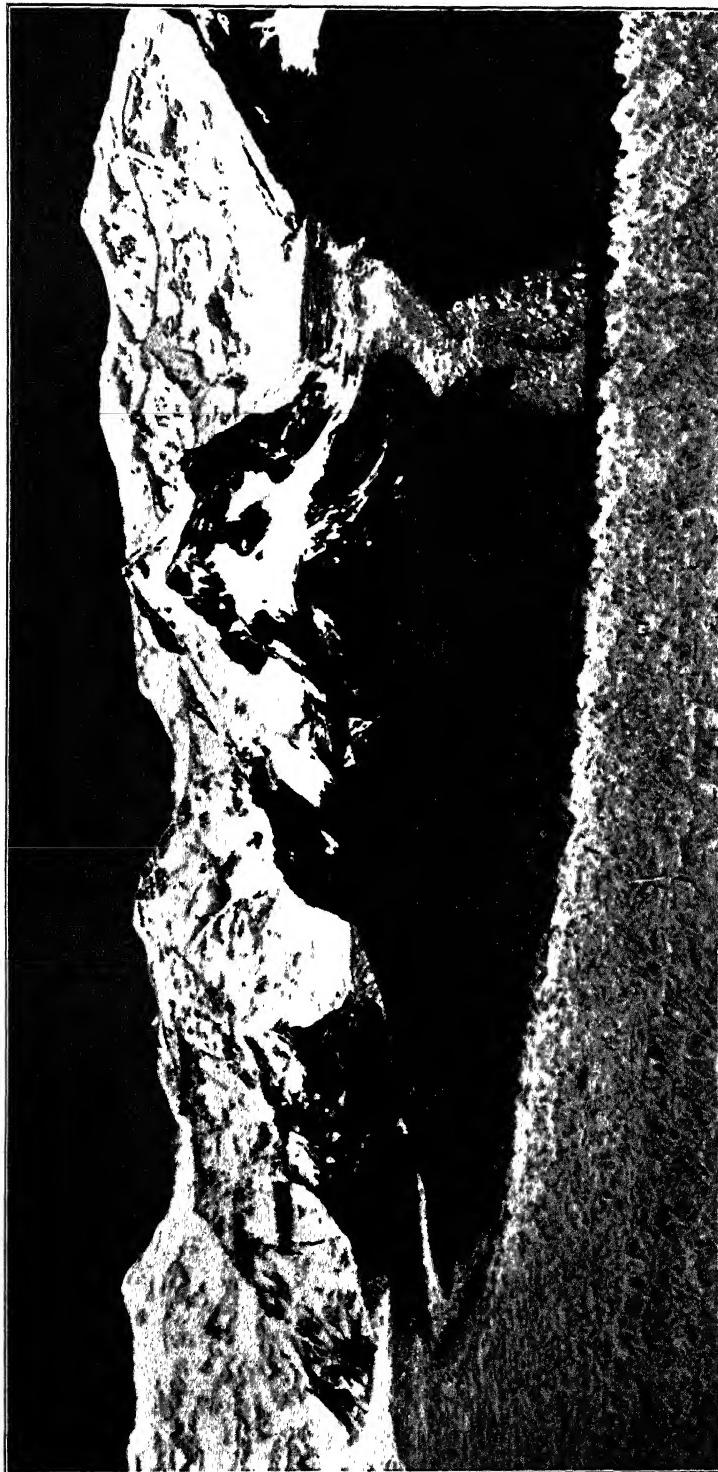
In these tests the bases were of various lengths up to about 900 metres, the smaller ones being measured with the subtense bar provided with the outfit, the larger ones being computed after resecting each end. In only one instance was the camera axis normal to the base, and on one occasion it was inclined as much as 50° to the normal. The camera was tilted downwards on two occasions, and at times the axes were convergent. The base was never horizontal, as much as 100 metres difference being measured between the two ends of one base. Both cameras were used, the focal lengths being 165 and 250 millimetres.

The views were taken across valleys, up and down valleys, in close and in open country, in order to find out what conditions were best. Camera stations, or one of them, were generally resected by the photo-theodolite, but in one or two cases I had to fall back on planetable resections. On these latter occasions the base was very carefully measured by the subtense bar.

I will mention a few points about the field work. Though the Wild Autograph will deal with, and actually did deal with, minor errors in the field, great care should be taken to level the theodolite carefully and to record correctly the various elements of inclination, tilt, and convergence. The Autograph finds out any errors and will correct them, but time is lost when setting if this has to be done. In the field there was some difficulty in getting suitable camera stations and bases, but this was chiefly due, though perhaps not entirely, to the high altitude and my own lack of experience.

It is essential to use first-class plates and to take great care with the photography. The Imperial Special Process Plates left nothing to be desired, and were in every way excellent. But however perfect the plates I am convinced, from previous experience, that where definition is essential, as it is in long-distance micro-stereophotography, the development of the plates must take place in the field. I am certain that after exposure to light even the best emulsions tend to deteriorate if development is delayed. I personally

TERAM KANGRI I
24,489.



TERAM KANGRI FROM THE NORTH-EAST, ACROSS THE KYAGAR GLACIER.

developed all my negatives in the field by the tank method as soon after exposure as possible.

I now come to the actual plotting of the results. The Government of India placed me on deputation to Switzerland for one month with Lieut.-Colonel Sackville Hamilton of the Survey of India. Mr. Hinks was deputed by the Council of the Royal Geographical Society to join us and study the working of the Autograph. Before leaving for Switzerland, Mr Hinks and I collected all our data in what we considered the most suitable form, the former kindly converting my spherical co-ordinates to rectangular.

Dr. Helbling very kindly allowed us the use of an Autograph for one month, and placed the services of Mr Guido Hunziker, his chief engineer, at our disposal for that period. I wish here to acknowledge our very deep gratitude to these two gentlemen for all their courtesy and assistance. The plotting itself was done by Mr Hunziker and myself, taking turns at the Autograph.

We plotted three maps, one for each type of experiment. The accuracy test is on the scale of 1 : 50,000; the long-distance test is on a scale of 1 : 250,000; and the Nubra experiment 1 : 125,000.*

I will now take each map separately. We selected the Kyagar glacier and neighbourhood for the first test, partly because we had more control points, and partly because we could combine more pairs of photographs, and therefore could test the junctions of pairs better. Here we had four camera stations, W4, W5, W6, and W7, on the ridge east of the Kyagar glacier, and on the bases W5W4, W6W4, W6W5, W7W5, and W7W6 we had five pairs of photographs taken with the small camera. My stations were resected from the Survey of India positions for Teram Kangri I, the Gasherbrums, and K², and one of my own less accurate points. The centre pair was controlled primarily on Teram Kangri I, and the adjacent pairs were set on points of detail derived from the first pair and checked on the trigonometrical control. The rest of the detail of these other pairs agreed most satisfactorily. On the left, Grant Peterkin's peak No. 27 coincided almost exactly with the Autograph position, and the height was correct within 20 feet. Colonel Wood's two points, 16¹ and 16², fell on the Muztāgh crest-line, though as they were not peaks but only points on the ridge, it is not possible to say whether they are absolutely exact. Teram Kangri III agreed perfectly in the next pair to the right, and accurate positions of the other salient peaks of the range in the neighbourhood of these peaks have been obtained. These positions may be considered as trigonometrically correct. On the extreme right of the series of photographs there was a difference of about 50 metres on the ground at a distance of about 10 miles between the position of a point plotted on this scale

* The three maps drawn by the Autograph are illustrated in the *Geographical Journal*, Vol. 70.

and series, and the position derived from another pair of photographs, taken with the large camera and set on K² and the Gasherbrums, between 30 and 42 miles away, plotted on the scale of 1 : 250,000. This is only 0·2 millimetre on the latter scale.

Mr. Hunziker and I spent a happy and interesting afternoon with the Autograph index traversing the glacier, and I am more than ever prepared to take off my hat to the first person who succeeds in crossing it on foot.* The best chance appears to me to be between the glacier and the marble cliffs, but it would mean probably at least three days' hard work with the axe to cut a track for climbers, and one may even then be held up by lakes. The snout here is about 2 miles across. Further up the glacier there are too many lakes and crevasses, to say nothing of the great ice pinnacles themselves, to render any passage practicable in its present condition, unless the eastern moraine is followed. This last leads to the eastern of the two Karakoram spurs, and from here a crossing appears to be practicable to the western promontory without excessive difficulty. But from this point the big glacier from Teram Kangri is a decided obstacle and much crevassed, though the pinnacles here are not more than 20 feet high. The western moraine does not look difficult, but it certainly will be most exhausting. The western side glaciers form obstacles, but by keeping to the main moraine for some way, the ends of these side glaciers can be passed. I think the whole passage by this route would take four or five days of strenuous work, and I recommend any one desirous of crossing to study the photographs in the stereoscope first.†

The Autograph came out very satisfactorily from this test. The second experiment deals with the distant plotting. The longest base I could get for photographing K² stereoscopically was about 900 metres. Even with a base of this length Gasherbrum I was almost lost behind the foreground of the left-hand view. K² is 42 miles away, "Broad Peak" 37 miles, and Gasherbrum II 33 miles. That is to say, neglecting the inclination of the camera axes to the normal, the ratios of base to distance were 1 : 84, 1 : 74, 1 : 66 for these peaks. With this base, 2935·5 feet to be exact, with the large camera, and with a measured convergence, we were able to plot the detail and the 250-foot contours of K² and the nearer peaks without much difficulty.

Combining my right-hand photograph here with another at W5, *i.e.* using a shorter base, 1054·1 feet, the ratios were reduced to 1 : 210, 1 : 185, 1 : 165, while Gasherbrum I appeared now with a ratio 1 : 150. Though it was still possible to plot the summit of K² within a quarter of a mile, it was no longer possible to plot the detail either here or in the neighbourhood of the "Broad Peak."

* See page 28. † These photographs are available at the Royal Geographical Society's House at Kensington Gore.

As however more detail could now be combined stereoscopically near the Gasherbrums, an attempt was made to plot the contours also. It was found that they could only be plotted with extreme care, by joining up successive plotted points of the same height. I would therefore suggest that the ratio 1 : 165 is about the limiting effective ratio for the automatic plotting of detail.

In this series the heights of Gasherbrum I and II and of K² agreed within a few feet of the triangulated heights, after setting the Autograph height drum correctly for the station heights and allowing for curvature and refraction. But Broad Peak appears in the Autograph to be only 26,400 feet in height, and not 27,132, as found by the Duke of the Abruzzi. If this peak had been at the edge of the plate, I would have given it the benefit of the doubt and assumed that either the instrument or I was at fault. But when controlled on both sides by such well-triangulated points as K² and the Gasherbrums for distance, direction and height, an error of the Autograph is not possible. The height was checked at once by Mr. Hunziker, and we are convinced that this height, 26,400 feet, is correct within 50 feet relative to K².

The other points of interest in this series are these. We were able to plot some of the great northern spurs of the Muztāgh-Karakoram range that enclose the Urdok and Gasherbrum glaciers. Neither the naked eye, nor the planetable, nor the Canadian method of photogrammetry could have found any detail whatever of these ridges, or could have even discovered their existence. They are rock and snow ridges against a background of snow and rock, and nothing but stereoscopy could hope to separate them or recognize individual points. In the Autograph these ridges stand out in wonderful relief and are easily plottable, thanks to the excellence of the objective and of the plates. I do not think that any of us quite believed that the Autograph would pick out these details, and Mr. Wild himself was certainly more than sceptical until he saw the diapositives in his stereoscope.

In this series we have also determined the positions of the snouts of two more glaciers beyond the Kyagar, and have plotted the bed of the Shaksgam far below any point we could see with the naked eye or without the magnification afforded by the Autograph. This point cannot have been more than a short distance from the spot reached by Sir Francis Younghusband, and must have been easily visible to him.*

From the photographs taken from the Tatar La, we were able to contour the northern faces of K² and Gasherbrum I, and to obtain additional information in their neighbourhood. The detail joined up quite satisfactorily with that plotted from the Kyagar stations.

* For the compilation of the topography of the Urdok glacier, see pages 66-68.

Another pair of photographs of this small-scale series is interesting. It was taken down the Sa Lungpa gorge, and at the time we were unable to identify for certain the distant peaks. We called them collectively "the Gasherbrums," but did not know which summits were concerned. After plotting the detail from the Kyagar stations we were able to identify the peaks in the Sa Lungpa pair, simply because four peaks fell on the plotted points and the heights agreed very well *inter se*. The three Gasherbrums concerned were II, III, and IV.

I must draw attention here to the correction necessary for refraction and curvature. The Autograph will not allow for this automatically. Mr Hinks therefore worked out a curve for the necessary corrections, and Mr Hunziker kindly converted this to a scale. This scale was used for the plotting of individual heights, and great accuracy was obtained with it. When setting the height drum for the plotting of contours, it was found quite accurate enough to divide the area into distance zones, each with a separate correction. With a little practice this method of correction became quite rapid.

I will now turn to the last series. On my return through Nubra, the Khan Sahib's survey was closed at Pānāmik. We then marched towards Leh, and it occurred to me that I might improve the existing map by photography. The map is very much out of date, badly controlled by very few triangulated points, and the hills are very weakly and inadequately shown by hachures. I took four pairs of photographs on a long day's march near the Nubra-Shyok junction, noting only one doubtful triangulated point in all the four pairs and without being able to resect my camera stations. At each of these I observed a round of angles with the theodolite, including my base, the camera axis, the doubtful point, and other unknown points in the views. The result was quite satisfactory, and the Autograph map will on reduction fit over the existing map and greatly improve it.

The experiments bring out certain points about the field work that are probably well known to those who are using the method regularly, but which I had no means of knowing beforehand. The most ideal conditions for field work may be summed up as follows:

- (a) Stations should be higher than the ground surveyed.
- (b) Camera axes should be depressed, in order to prevent too much dead ground.
- (c) Camera axes should be inclined not more than 30° to the normal to the base, to get full advantage of the base length.
- (d) The ratio of base to distance should be if possible between 1 : 10 and 1 : 30; but it is still *quite easy* to plot, if these are extended 1 : 6 to 1 : 60; and it is still *possible*, if the ratio is decreased to 1 : 160.

- (e) Photographs taken across valleys, are to be preferred to those taken up or down valleys. The former will have a more limited field of view, but will be far more complete than the latter, which will however be suitable if the method is only required for fixing additional control points.
- (f) For contouring the flat bottoms of valleys, stations should be sited as high as possible, and the camera tilted down as much as possible. If low stations only are available, details of roads, etc., are apt to be obscured by trees, and tracing of contours also becomes less exact, owing to grazing rays of observation.
- (g) It is important that shadows should not be too heavy, and they should be approximately the same in the right- and left-hand views. Otherwise stereoscopic relief is not easy. For the same reason, dense featureless snow slopes on the negative are difficult to plot where the sun blazes on them and obliterates detail. Where in nature dense white slopes are combined with heavy dark rocks, it might be advisable to take two pairs of photographs with different exposures.

The success of all these experiments exceeded our expectations. This is no doubt partly because of the climate and atmosphere of the Aghil ranges; but there is no doubt that it is mainly due to the excellence of the design of both the field and the office apparatus. At the same time I connot close this chapter without saying that the accuracy of Colonel Montgomerie's triangulation of the great peaks seventy years ago has enabled us to prove the value of this new method to-day.

CHAPTER IX

GEOLOGY

SECTION A

FIELD OBSERVATIONS

AS will be seen from an examination of the list of rock specimens brought back by the expedition, not a single specimen of gneiss or granite was obtained *in situ*, after crossing the Saser pass, with the very doubtful exception of the last specimen (No. 42) obtained in the valley of the Zug-Shaksgam. The greater part of the rocks in the areas explored by us were marbles and limestones, often with a deep wine-red colour, and black gritty shales and sandstones.

These limestones and marbles were not unexpected, for De Filippi, after the Duke of the Abruzzi's expedition of 1909, by examination of the rocks composing the various moraines of the upper Baltoro glacier and by a close study of photographs, concluded that the great peaks, "Broad", Gasherbrum IV and I, and "Golden Throne" were all formed of limestone and dolomite. Photographs taken from the south, east and west of K², appeared to show in that peak a well-marked stratification with gentle dips of about from 15° to 20°, and greatest in the terminal pyramid. Ing. Novarese, of the Italian Geological Survey, who studied the results, considered that this was probably due to gneiss and disagreed with Colonel Godwin Austen's opinion that the stratified summit was more recent than the granite base. The latter does not seem to have considered the question as to whether the granites may have been intrusive into the stratified rocks of the summit, and therefore younger in age.

Longstaff, almost simultaneously with the Abruzzi expedition, noticed that the moraines on the left of the upper Siachen glacier, like those on the right of the upper Baltoro, were composed of marbles and calcareous breccias, and the results of the Workman expedition three years later showed that Teram Kangri and the mountains north of the Siachen are predominantly of limestone.

There is therefore nothing outstanding in the discovery that the whole region north of the Muztagh-Karakoram axis is sedimentary in origin. In the absence of fossils among the moraine material south of the great peaks, the age of the rocks was however indeterminate. For a long time the presence of Palaeozoic and Mesozoic

rocks in the Chang-chhenmo region of Eastern Ladākh had been known; they had been described by Dr Stoliczka in 1878, and at a later date by Lydekker, who found dolomites with Upper Trias fossils. This Palaeozoic and Mesozoic area formed an elongated strip running north-westwards parallel to the gneissic mass of Baltistān. It had been traced in the upper Shyok valley as far north-west as Saser Brangsa. The discovery of limestones in Teram Kangri and the Gasherbrums and far to the north-west in upper Hunza was a weighty argument in favour of a long stretch of this band of mesozoic limestone from Eastern Ladākh to Northern Hunza.

Subsequently, Sir Henry Hayden considered that the Pámír Limestones were Jurassic. The discovery by us of marine fossils of undoubtedly Jurassic age among the limestones and sandstones of the previously unexplored Aghil region fits in remarkably well with the earlier observations to the south and west of the area. It seems however probable that the mesozoic band is very much wider than was originally supposed.

These Jurassic fossils show that the sediments in which they occur were laid down when the Tethys Sea still covered this area. But the presence of sandstones and shales seems to indicate this sea was during Jurassic times growing shallower. No fossils of a later date were found, and it seems probable that early in Cretaceous times the Shaksgam-Aghil area emerged from the sea and has ever since been dry land.

The glaciers north of the Muztāgh-Karakoram may be divided into four types, (1) Longitudinal, (2) Transverse, (3) Cap, and (4) Saddle.

These types have no definite dividing line, and the branch glacier of one type may join the trunk of another. Generally speaking the glaciers draining the northern wall of the Muztāgh-Karakoram appear to be longitudinal and not transverse, as might have been expected. The four that we observed, and the Urdok of Sir Francis Younghusband, are all similar in type, though the last is more fortunate both with its lateral moraines and with 'the billowy mass of moraine' which takes the place of the ice pinnacles at the lower end of the glacier. Sir Francis records that the end of this glacier has the appearance of a vast collection of gravel heaps. With the Kyagar glacier and the next two glaciers down the valley, as we could see in the stereoscope, the ice pinnacles continue right down to the snout. All these glaciers have probably an open névé field at their head, which is gradually split up by crevasses before the region of pinnacles is reached.

The small glaciers on the northern mountains of the Shaksgam are also longitudinal, and they terminate at the point where their valleys begin to become transverse. It seemed to me that at one time the whole of the Shaksgam had been filled by an enormous glacier, lying obliquely across the 'strike' and extending at least

as far as the Urdok, and probably beyond.

The glaciers on the right bank of the Lungmo-chhe, though smaller, are also longitudinal and pinnacled. They have evidently retreated since Wood was here in 1914, and now leave wide passages for the river. The one that blocked the valley completely twelve years before our visit and whose snout then rested against the cliffs of the north-west bank, has retreated at least a hundred yards, leaving isolated pinnacles of ice near the right bank, washed by the river. For another hundred yards or so the glacier end is composed of "dead" pinnacles, between which a passage can easily be threaded without walking on ice. In a year or two, unless the glacier advances, these pinnacles will have melted and there will be a clear passage on the right bank. We were most fortunate in being able to observe this glacier in its dying condition.

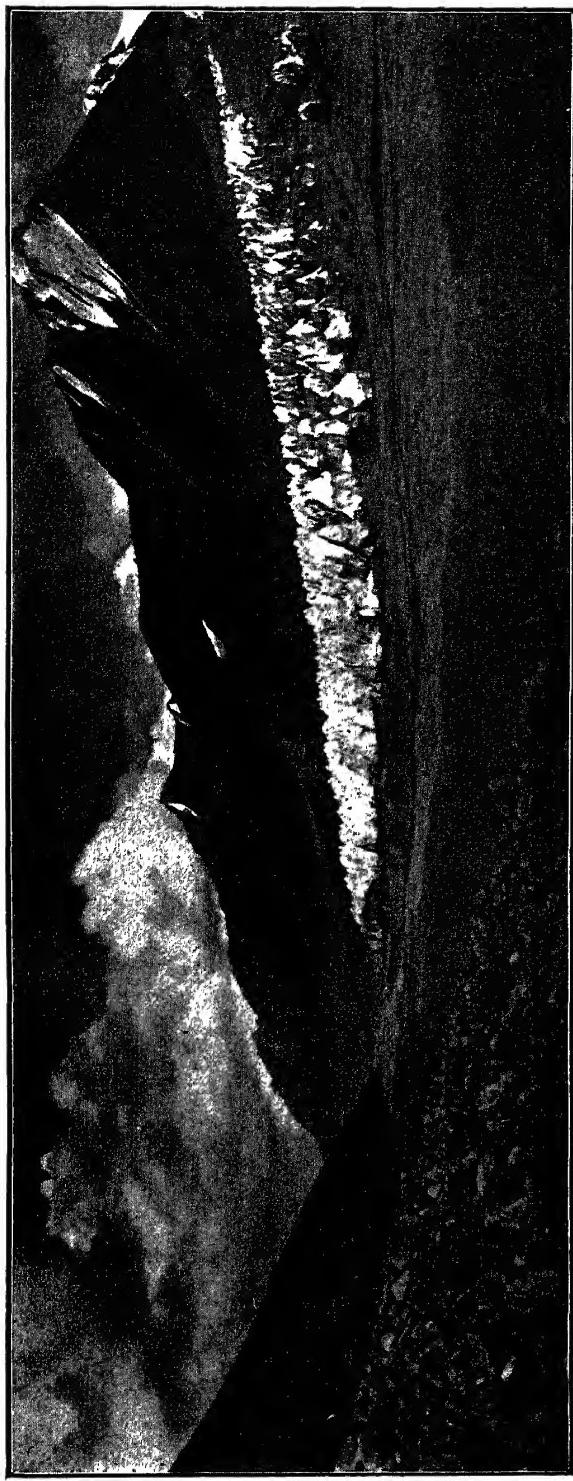
The "Transverse" type of glacier afforded us no particular points of interest. The floors on which they rested were generally much steeper than those of the first type, and they were consequently more crevassed when changes of slope occurred. But they were rarely pinnacled, and the ice towers were comparatively insignificant. The left bank tributary glaciers of the Kyagar are typical of this class.

The "Cap" type of glacier is really little more than the permanent snow cap resting on the top of a mountain. It is not a true glacier at all. The ice moves slowly downwards, and masses break off at the lower extremity. It has a "clotted cream" appearance, due to the irregularity of storms above the permanent snow line, which tend to replenish the wastage caused by melting and flow.

The "Saddle" type of glacier may be regarded as an elongated form of "Cap" glacier, often draining from a mountain to the watershed between two valleys. With the exception of the Saser glacier, which is complicated by the presence of several others, the Lungpa Marpo glacier was the most complete form of "saddle" glacier. The cantle at the north-west extremity must supply the ice for the Lungmo-chhe saddleflap. Yet both flaps fall steeply, and one would have expected them to have parted company with the névé, leaving open crevasses. This however is not so.

The Sa-Kang La is covered by a curious example of the type. If either of its two glaciers were removed, the other would drain into both the Lungmo-chhe and the Sa Lungpa. As it happens, their trunks form a combined saddle-bow, nearly four miles wide, with small flaps each side. The glacier-saddle resting on pass "G" is faintly similar to the last, but is a single glacier which has lost its saddleflaps. It has so diminished in volume that it leaves an easy passage.

The "saddle" glacier by the Tatar La has almost lost its western flap, but still retains a pronounced eastern one. This is



A DYING GLACIER IN THE LUNGMO-CHHE.

Photo-engraved & printed at the Offices of the Survey of India, Calcutta, 1928.

complicated by the presence of the Aghil Depsang, which appeared to me to have been at one time covered entirely with a protective ice-cap, and which has therefore given less fall to the glacier streams.

I have indicated above that the only glacier that Wood described and that we were able to observe has most certainly retreated in the last twelve years. This does not prove by any means that glaciation is diminishing in this area over a long period. It may merely be a small secular change in this one glacier. Nevertheless from other signs which we observed, I believe that these are now much smaller than they have been. This fact was particularly noticeable on the Aghil Depsang, where the glaciers themselves rested on the surface of the plateau, and appeared to be the remains of a much more extensive glaciation. The waters draining them have begun to carve small ravines and gorges beginning almost at the snout of the glaciers. The surface of the plateau was composed of loose stones, a typical one of which has been found to be silicious breccia, while the naked rock walls of the Tatar Lungpa are mainly of grey limestone and black sandstone, often with calcite veins, and generally with a nearly vertical dip.

In the main tributaries, and particularly in the Zug-Shaksgam, there are signs of recent rejuvenation of the streams, for the river deposits of red sandstone and conglomerate have been cut through again by the silt-laden water, and conglomerate cliffs are a common feature on the borders of many of the flood-beds. This seems to me to indicate that the higher watersheds are still being elevated slowly, but it may of course be merely due to the clearing of obstructions such as landslides, lower down the course of the river, and therefore a more rapid current.

The country is unfinished. Changes are rapidly occurring. Though the mud avalanches of Hunza are not a common feature in the Shaksgam, there are frequent falls of rock, which are mainly due to the freezing of moisture in fissures; and in many places the outcrops are in a very unstable condition. The least touch will bring down a large fall, such as occurred in the Yarkand river when a Gurkha was badly hurt.

Many of the saddle glaciers hold up glacier lakes for some period of the year, but these do not seem to be of any permanence. As they fill during the summer thaw, they burst their glacier obstructions, rapidly empty, and cause minor floods down the course of the river. These floods are destructive to the river banks and help to carve down the walls of the gorges.

Both in the Lungmo-chhe and in the Zug-Shaksgam we came across a number of granite boulders. In the latter valley they were extremely common and often lay in regular fan-shaped lines radiating from a side ravine. This would seem to indicate that there is a core of granite somewhere in the mountains behind, from which

these boulders have been transported by glaciers. Yet nowhere did we find granite *in situ*, though Clifford made several ascents north of the Lungmo-chhe in search. The presence of this granite remained a mystery to us, and the only explanation seems to be that they were transported here from some more distant source by ancient glaciers.

I am indebted to Mr. E. L. Clegg of the Geological Survey of India for the following detailed examination and classification of the rock specimens collected by Clifford and myself.

SECTION B

SYSTEMATIC CLASSIFICATION OF ROCKS AND FOSSILS

by Mr E. L. CLEGG, Curator, Geological Survey of India.

(A). Eight rock specimens from the proximity of the trade-route between the northern foot of the Khardüng pass and Saser Brangsa.

| | Approximate Latitude Longitude | | |
|--|--|-----------|---|
| No. 1. <i>Col. No. 35.</i> From large boulder, foot of Khardüng pass. | ... | ... | Vein quartz. |
| No. 2. <i>Col. No. 34.</i> Cliff left bank Shyok R., mouth of Khardüng ravine. <i>In situ.</i> | ... | ... | Quartz-porphyry. |
| No. 3. <i>Col. No. 33.</i> Intrusion in granite, rock face, road to Um- lung from Nubra. <i>In situ.</i> | 34°53'40" | 77°31'20" | Quartz-schist. (original quartz- porphyry). |
| No. 4. <i>Col. No. 32.</i> Close to No. 3 above. <i>In situ.</i> | 34°53'40" | 77°31'20" | Calcite. |
| No. 5. <i>Col. No. 31.</i> Floor of valley of Thulan-buti. $2\frac{1}{2}$ miles SW. of Skyangpo-chhe. <i>In situ.</i> | 34°59'25" | 77°34'18" | Quartz-porphyry. |

| | Approximate Latitude Longitude | | |
|--|--|-----------|--------------------------|
| No. 6. <i>Col. No. 30.</i> Above camping ground Skyangpo-chhe, base of hill. <i>In situ.</i> | 35°00'20" | 77°36'10" | Picrite. |
| No. 7. <i>Col. No. 29.</i> Saser pass cliff, side of road, Bongro-chan, <i>In situ.</i> | 35°02'20" | 77°42'30" | Olivine-gabbro. |
| No. 8. <i>Col. No. 27.</i> Saser pass cliff, about 2 miles from Shyok snout, left bank. <i>In situ.</i> | 35°03'20" | 77°44'50" | Slicken-sided gneiss. |

Nos. 6 and 7 are basic plutonic rocks; the gabbro consists of augite, plagioclase, felspar and olivine, with magnetite as a secondary product; the augite is colourless, but is altering to pale green pleochroic hornblende; the felspar is basic (labradorite-bytownite) and shows lamellar twinning, whilst the olivine displays its characteristic alteration. No. 6 consists of plate-like crystals of augite together with a little plagioclase felspar, whilst magnetite is also present. Symmetrical sections of felspar (bytownite) extinguish at about 27° and show lamellar twinning, whilst the colourless augite extinguishes at 30°.

Nos. 2, 3 and 5 are probably specimens taken from different parts of the same occurrence, as Nos. 2 and 5 are practically identical rocks, whilst No. 3 differs only that it has been subjected to greater pressure and shows a greater degree of metamorphism. No. 2 is a porphyritic acid rock consisting of phenocrysts of quartz and felspar in a microcrystalline quartzose ground-mass. Both orthoclase and plagioclase felspars are present, one crystal of the former exhibiting a Baveno twin, whilst the latter show lamellar twinning. Quartz phenocrysts predominate, and both the quartz and felspar phenocrysts, though much corroded, show remnants of their original idiomorphic outlines. The ground-mass consists of quartz, some of which from the stringing out of quartz mosaics appear to be of a secondary nature. Quartz spherulites in the ground-mass may be due to devitrification of a quartz glass. No. 5 is a similar rock to No. 2, differing only in the fact that the felspar phenocrysts are not so numerous as in No. 2. In the hand, specimen No. 3 appears very different from Nos. 2 and 5, but under the microscope its original porphyritic nature is seen. It appears to be a metamorphic derivative

of Nos. 2 and 5.

No. 8 is an ordinary type of Himalayan gneiss, and there is nothing of special interest in Nos. 1 and 4.

(B). Three rock specimens from outcrops on left bank of Yarkand river.

| | Approximate Latitude | Longitude | |
|--|-------------------------|-----------|-----------------|
| No. 9. Col. No. 26. White vein in greyish rock, Stream "B" Yarkand river, right bank, 3 miles from "Amphitheatre". <i>In situ.</i> | 35°34'30" | 77°36'50" | Vein quartz. |
| No. 10. Col. No. 44. From outcrop at mouth of left bank tributary to Yarkand R. <i>In situ.</i> | 35°49'30" | 77°37'30" | Clear quartz. |
| No. 11. Col. No. 23. From large outcrop, left bank, Yarkand R., just above Lungmo-chhe junction. <i>In situ.</i> | 35°53'53" | 77°32'00" | Micaceous grit. |

(C). Eleven rock specimens from the Lungmo-chhe.

| | | | |
|---|-----------|-----------|--|
| No. 12. Col. No. 22. From large outcrop, near mouth of Lungmo-chhe, right bank. <i>In situ.</i> | 35°54'55" | 77°30'30" | Micaceous grit. |
| No. 13. Col. No. 45. From sand patch, left bank Lungmo-chhe. | 35°53'05" | 77°26'05" | Fragments of Chalcopyrite-malachite on weathered surfaces. |
| No. 14. Col. No. 25. From cliff of "Low Col", Lungmo-chhe. <i>In situ.</i> | 35°52'42" | 77°21'19" | Chert showing slicken-siding. |

| | Approximate Latitude Longitude | |
|---|--|--|
| No. 15. Col. No. 24. From broad vein in limestone outcrop, near stream opposite 1st glacier, Lungmo-chhe. <i>In situ.</i> | 35°49'15" 77°20'30" | Chip of pegmatite. |
| No. 16. Col. No. 21. From large boulder high up on cliff, Lung- mo-chhe. | 35°46'55" 77°20'00" | Chip of pegmatite. |
| No. 17 (a), (b). Col. No. 19. From boulders of Lungmo-chhe. | 35°46'55" 77°20'00" | Biotite granite (a) Hornblende granite (b). |
| No. 18. Col. No. 20. Cliffs above camp, Lungmo-chhe, left bank. <i>In situ.</i> | 35°47'00" 77°17'30" | Dolomitic lime- stone. |
| No. 19. Col. No. 37. From cliff, right side of 3rd glacier, right bank, Lungmo-chhe. <i>In situ.</i> | 35°45'50" 77°17'00" | Iron pyrites impreg- nating micaceous sandstone. |
| No. 20. Col. No. 38. From cliff ten yards downstream of No. 19. <i>In situ.</i> | 35°45'50" 77°17'00" | Grey limestone. |
| No. 21. Col. No. 39. From stream bed, Lungmo-chhe. | 35°45'50" 77°17'00" | Small pyritous concretions probably from shale. |
| No. 22. Col. No. 7. From head of second glacier, Sa-Kang La, Aghil Range. | 35°47'10" 77°12'00" | Quartz. |

Nos. 15 and 16 are chips of pegmatite; No. 17 (a) is a typical biotite-granite consisting of quartz, felspar and biotite with magnetite as an accessory mineral. Both orthoclase and oligoclase-felspar are present, the latter predominating and showing zonal structure. The biotite is strongly pleochroic (dark brown to pale yellow).

No 17 (b) is a hornblende granite consisting of quartz, felspar and hornblende with a little biotite mica. Orthoclase and oligoclase felspars are both present, the latter showing zonal structure. The hornblende is of the green variety, is strongly pleochroic and shows twinning, whilst basal sections show the characteristic well-marked cleavages. Both the quartz and felspar show strain phenomena, and the granite has been slightly metamorphosed.

Both these granites Nos.17(a) and 17(b) occur as boulders, and have probably been brought down by some ancient glacier from a distant source. No granite was observed *in situ* anywhere near the existing glaciers, nor on the watersheds enclosing them; it was a complete mystery whence these boulders came.

For the fossils of the Lungmo-chhe and Sa Lungpa below.

(D). Seven rock specimens from the country between the Lungmo-chhe and valley "J".

| | Approximate | | |
|--|-------------|-----------|---|
| | Latitude | Longitude | |
| No. 23. Col. No. 40. From cliff, left bank "Low Col Stream" gorge. <i>In situ.</i> | 35°52'45" | 77°21'30" | Limestone (whitish). |
| No. 24. Col. No. 41. As above, just below gorge. <i>In situ.</i> | 35°52'45" | 77°21'30" | Grey limestone. |
| No. 25. Col. No. 42. As above, 2 miles gorge. <i>In situ.</i> | 35°53'54" | 77°21'00" | Grey limestone. |
| No. 26. Col. No. 16. As above, 3½ miles from junction with valley "J". <i>In situ.</i> | 35°57'10" | 77°23'55" | Little chalcopyrite in crystalline rock. |
| No. 27. Col. No. 43. As above, just above junction valley "J". <i>In situ.</i> | 35°59'15" | 77°24'45" | Pink limestone. |

| | Approximate Latitude Longitude | | |
|--|--|-----------|---------|
| No. 28. Col. No. 17. From outcrop in Lung-mo-chhe—valley “J” watershed. <i>In situ.</i> | 35°55'10" | 77°26'00" | Jasper. |
| No. 29. Col. No. 18. From outcrop in side valley of “Low Col Stream”. <i>In situ.</i> | 35°55'10" | 77°25'45" | Jasper. |

For the fossils in this area, see below.

(E). Eight rock specimens from the Aghil Depsang, the Tatar Lungpa, and the Kalmuk Lungpa.

| | | | |
|--|-----------|-----------|---|
| No. 30. Col. No. 6. Lying loose on the Aghil Depsang. | 35°58'30" | 77°03'50" | Hemihedral quartz crystals, probably derived from an open vein or cavity. |
| No. 31 Col. No. 15. Aghil Depsang, loose and typical. | 36°00'00" | 77°01'20" | Siliceous breccia. |
| No. 31 Col. No. 5. Outcrop in Tatar Lungpa. <i>In situ.</i> | 36°00'20" | 77°01'40" | Piece of chert. |
| No. 33* Col. No. 1. Outcrop in Tatar Lungpa. <i>In situ.</i> | 35°59'40" | 77°01'00" | Grey limestone. |
| No. 34 Col. No. 14. Outcrop on summit of Tatar La. <i>In situ.</i> | 35°58'30" | 76°59'15" | Fragment of sandstone with calcite vein. |

* There is a little doubt as to the exact location of this specimen (K.M.)

| | Approximate Latitude | Longitude | |
|---|-------------------------|-----------|--|
| No. 35. <i>Col. No. 8.</i> From outcrop in Kalmuk Lungpa, 6 miles from mouth. <i>In situ.</i> | 35°59'30" | 76°55'30" | Gritty slate and fine grained micaceous sandstone. |
| No. 36. <i>Col. No. 3.</i> From Kalmuk Lungpa. | 36°00'20" | 76°54'15" | Pyritous nodule. |
| No. 37. <i>Col. No. 46.</i> From Tatar Lungpa. <i>In situ.</i> | 35°59'20" | 77°00'19" | Chalcopyrite (originally formed in veins). |
| No. 38. <i>Col. No. 12.</i> From cliffs on right bank of Zug-Shaksgam. <i>In situ.</i> | 35°57'00" | 76°50'30" | Crystalline limestone. |
| No. 39. <i>Col. No. 11.</i> As above, about a mile downstream. <i>In situ.</i> | 35°57'50" | 76°51'15" | Calcareous tufa. |
| No. 40. <i>Col. No. 13.</i> As above, about two miles downstream of No. 39. <i>In situ.</i> | 36°00'00" | 76°52'30" | Crystalline limestone. |
| No. 41. <i>Col. No. 10.</i> As above, about 2½ miles downstream of No. 40. <i>In situ</i> | 36°02'30" | 76°53'30" | Uralitised ophitic dolerite. |

| No. 42. | Approximate | | |
|---|-------------|-----------|---------|
| Col. No. 9. | Latitude | Longitude | |
| From large rockcrop- ping out in river bed, $1\frac{1}{2}$ miles downstream of No. 41. Apparently <i>In situ</i> .* | 36°04'10" | 76°53'30" | Gneiss. |

These five rocks were taken as samples of the outcrops of the cliffs and valley walls on the right bank of the Zug-Shaksgam as this river passes north, through the southern ranges of the Aghil chain.

No. 42 was believed at the time to be cut from a large up-standing outcrop at the edge of the flood-bed of the river. It is just possible that this was not an outcrop, but an enormous boulder brought down by some ancient glacier. It is an ordinary type of Himalayan gneiss. No. 41 is a dolerite and consists of felspar and augite mostly altered to hornblende, whilst a little flaky biotite is also present as an original constituent. The felspar (labradorite) and augite show ophitic intergrowth, and the rock probably occurs as a dyke.

(G). Eleven Fossils collected in the Lungmo-chhe, the Sa Lungpa, and the "Low Col Stream". Provisional determinations.

| | | | |
|--|-----------|-----------|--|
| No. 1 (a) (b) (c) (d) | | | |
| Col. No. 1 | | | |
| Four fossils from the spur above the junction of the upper two branches of the Sa Lungpa, close to "Wild" stations Nos. 10 and 11. | 35°51'20" | 77°08'10" | Pecten sp. and Alectryonia sp. |
| Nos. 2 (a) (b) (c) (d) | | | |
| Col. No. 2 | | | |
| Several fossils from the upper north-west branch of the Sa Lungpa, on the hills above the left bank. | 35°52'30" | 77°05'50" | (a) Holcostephanus (Spiticeras) aff. scriptus Strachey. (b) Holcostephanus (Spiticeras) Spitiensis Blanf. (c) Perisphinctes(?) indet. fragments. (d) Fragment of Rhynchonellid. |

* Possibly from enormous boulder, deeply embedded.

| | Approximate | | |
|---|-------------|-----------|---|
| | Latitude | Longitude | |
| No. 3. Col. No. 3. Fossil from the head of the Lungmo-chhe. | 35°46'10" | 77°15'30" | Perisphinctes (?) sp. |
| No. 4. Col. No. 4. Fossil from the head of the Lungmo-chhe. | 35°46'10" | 77°15'30" | Perisphinctes (Virgatosphinctes) aff. densiplicatus Waagen. |
| No. 5. Col. No. 5. Piece of rock con- taining small fossils from outercrop in stream- bed, Lungmo-chhe, opposite 3rd glacier. | 35°46'00" | 77°16'40" | Indeterminable fragments of Rhynchonellid, Ostreid, and lamellibranch shells. |
| No. 6. Col. No. 6. Piece of fossil from the head of the Lungmo-chhe. | 35°46'00" | 77°15'30" | Fragment of a Rhynchonellid. |
| No. 7. Col. No. 7. Fossil in piece of stone from "Low Col Stream" bed just above gorge. | 35°52'45" | 77°21'30" | Indeterminable fragments of Alectryonia. |
| No. 8. Col. No. 8. Piece of rock con- taining fossils from the bed of "Low Col Stream", just above the junction with valley "J". | 35°59'15" | 77°24'45" | Indeterminable fragments of Alectryonia or Exogyra. |

The above fossils were examined in the first place by Mr. G. H. Tipper, Superintendent of the Geological Survey of India, who considered that they were of Jurassic age and probably the equivalent of the Spiti shales. A detailed comparison with the hitherto described species of the Spiti shales by Dr G. E. Pilgrim, Superintendent, and Mr P. N. Mukerji, Sub-Assistant of the Geological Survey of India, does not reveal any absolute identity, but several

of the specimens of Ammonites are allied to forms from the Spiti shales. There is no doubt that the fossils are of Jurassic age, nothing being present which indicates any other age than this, though the horizon may not be actually the same as that of the Spiti shales. In any case, the occurrence is interesting as testifying to the presence af a large stretch of Upper Jurassic rocks in a geologically unknown area.

It is interesting to note that the formation designated by the late Sir Henry Hayden "the Pamir Limestone" and considered by him to range in age from Triassic through Jurassic to Cretaceous, lies on the strike of the region visited by the expedition. (See *Records, Geological Survey of India*, Vol. xiv, p. 304 and plate 32).

CHAPTER X

ANIMAL LIFE

- A. GENERAL REMARKS.
- B. DETAILED NOTES ON MAMMALS. (Captain Cave).
- C. CAPTAIN CAVE'S COLLECTION AND OBSERVATIONS OF BIRDS. (By Hugh Whistler, F.L.S., F.Z.S.).
- D. BUTTERFLIES. (Observations by Major Minchinton, and Identifications by Colonel W. H. Evans).

SECTION A

GENERAL REMARKS

THE area which was visited by the expedition and in which the main observations on animal life were made, is totally without human habitations, permanent, temporary or nomadic, although the Central Asian trade-route to Yarkand skirts its eastern margin. The valley bottoms of the Yarkand and Shaksgam river head-basins, which comprise the area, have the very high average altitude above sea-level of over 16,500 feet, while the mountains themselves, which include the Muztagh and Aghil systems, rise to some of the highest in the world. The whole country is intensely barren; there are no trees, no shrubs, and even grass is very scanty; in some places even this last is conspicuous only by its absence. The hardy, woody scrub, known as *burtsa*, which serves as fuel, exhibits by its nature and its scarcity in some parts the severe conditions under which vegetation struggles for existence.

As a whole the country is very exposed to weather changes, being largely affected by high winds from the glaciated regions of the Muztagh-Karakoram range; and though these same white regions protect it to some extent in summer, yet it must be completely covered under a mantle of snow during the winter months. In the head of the Yarkand river, (the "Amphitheatre"), as late as the end of June, there was still very little grass even in sheltered spots; but this increased gradually, till by the end of July there were considerable patches of it, both here and in the Lungmo-chhe. Nevertheless, by September, it was withering and dying, the brief summer was over, and the still briefer autumn had begun.

It will be observed from the foregoing remarks that in some aspects the area under consideration resembles the higher plateaux in Western Tibet, the Chang-thang, and north of the Chang-chhenmo; while in others it approximates to the gorge country east of the Hunza river and north of the Shingshal river. From almost every aspect it is unlike the country south-west of the line of the great peaks of the Muztāgh-Karakoram. There are no great ice-streams or bold granite mountains north of the Shaksgam; and disintegrating limestone, sandstone and shale rocks take their place.

A comparison of the Shaksgam-Yārkand river basins with the areas east and west of them shows that these basins are more eroded, the valley bottoms are lower and the mountain sides are more disintegrated than those of the Chang-thang. But they are less so in every case than those of the Khunjerāb-Ghujerāb region of Hunza; and being higher they support far less vegetation, and therefore far less life.

In such a country animals must be almost entirely nomadic or migratory; if any remain throughout the year, they must have a desperate struggle for existence. Some may hibernate, and some may perhaps lie up in localities where the conditions are less severe, as for instance in the Lungmo-chhe. But man, if he existed here, would have to be nomadic, for agriculture is impossible and he could only support himself by the chase.

Mammals. Owing to difficulties of transport, no systematic collection of mammals was made, and the notes which follow later are almost entirely the result of observations by Captain Cave. It will be noticed that the larger mammals show a definite affinity to those towards the east. There were of course no *Ovis ammon* or *Shapu*, which do not extend as far as the Muztāgh-Karakoram range from the south. But there appear also to be no markhor or ibex, the last of which are found on very similar ground in Hunza and on more open ground on the Tāghdumbāsh Pāmir. Nor are there any *Ovis poli*, for the ground was not open enough for them. The Tibetan antelope (*Panthalops hodgsoni*) and the burrhel (*Ovis nahura*), were on the other hand common; the former is unknown in Hunza, and it was somewhat of a surprise to find him so far west. Burrhel are rare in Hunza, but not unknown, two specimens having been shot in the Shingshal valley by the Visser expedition of 1925; and they are of course found west of the Saser pass in Ladākh, though not far west.

These observations fully bear out the theories of distribution put forward by Major Gerald Burrard in his recent publication on Himalayan game.* Major Burrard has studied the question for some years, and I believe that if I had been able to go to him and

* *Big Game Hunting in the Himalayas and Tibet*, by Major Gerald Burrard, D.S.O., R.A., (retired), London, 1925.

describe the nature of the country, he would have been able to say exactly what game we found.

Birds. A collection of birds was made by Captain Cave, who spared no pains to make his record of observations and his collection of skins as complete as possible under the circumstances. Almost every evening he spent at his skinning operations. The collection has been identified by Mr. Hugh Whistler, F.L.S., F.Z.S. There are apparently no new species or races, but the records are interesting as evidence of distribution and more particularly, of migration. Mr. Whistler in fact remarks that the very high elevations at which many of the migrants were observed form one of the chief points of interest in the collection.

A very small number of birds of prey was seen, but there were a few eagles and kites. Pony carcases often remained for several days untouched by scavengers. Throughout the short summer a few duck were found on occasional lakes; they were stray migrants, halting for a day and gone the next. In July, a brood of young duck was seen on Hayward's Lake, and in September this spot was the halting place for pintail and teal. A few flocks of Tibetan sand-grouse (*Syrrhaptes tibetanus*), each consisting of about a dozen birds, passed over the Aghil Depsang at an altitude of about 18,000 feet, and rested for a day early in August; these too must have been migrants, for no more were seen. The common chukor was not found, but the Tibetan snow-cock, (*Tetraogallus tibetanus*) was much in evidence in the Lungmo-chhe. From the end of July until September when the valley was quitted, every side ravine of the Lungmo-chhe held a family, and sometimes two or three families.

Besides this snow-cock, the commonest local birds were the following: Ravens (*Corvus corax tibetanus*); Horned Larks (*Otocoris alpestris longirostris* and *O. elwesi*); Mountain Desert Wheatears (*Oenanthe deserti oreophila*); Brandt's Mountain Finches (*Fringilla lunda brandti brandti*); and Guldenstart's Redstarts (*Phoenicurus erythrogaster grandis*).

Many migrants were observed halting at great elevations on their way south. Neither the species nor the dates on which they were observed were unusual, but the records give interesting indications of the existence of migration routes directly over the mountains. The following migrants may be mentioned in this category: Lesser Whitethroat (*Sylvia curruca affinis*); Greater Whitethroat (*Sylvia communis icterops*); Red-headed Bunting (*Emberiza icterica*); Bluethroat (*Cyanosylvia svecica pallidogularis*); Syke's Blue-headed Wagtail (*Motacilla flava beema*); Tree Pipit (*Anthus trivialis*); Hoopoe (*Upupa epops*); Cuckoo (*Cuculus canorus*); Green Sandpiper (*Tringa ochropus*); Ruff (*Philomachus pugnax*); Curlew Sandpiper (*Erolia ferruginea*); Little Stint (*Erolia minuta*); Temminck's Stint (*Erolia temminckii*); Marsh Harrier (*Circus aeruginosus*).

Fishes. No fishes were observed in the upper basins of the

Yarkand river or its tributaries, nor in the upper Shaksgam river. About 150 fish about the size of sardines were caught in a backwater of the Zug-Shaksgam at about 14,000 feet on the afternoon of 25th August, following a ten-foot rise of the river and a snowstorm higher up the valley. No others were seen.

Insects. Insects were not generally collected, but a collection of butterflies was made by Major Minchinton.

Of other insects seen, by far the commonest were the black spiders, generally found among the rocks and pebbles of the river beds. There appeared to be two types; the larger round-bodied small-headed species, which appeared to be mainly *body*, resembling a split pea in shape. The other type had a head as large as its body and appeared flatter and more square. Both kinds were very quick at taking cover under stones when alarmed.

On a small clear lake in the hills north of the upper Shaksgam, at an altitude of over 17,000 feet, there were millions of what appeared to be common midges (Chironomides or blood-worm midges?). At the end of July, the common black midge existed as a plague on Hayward's Lake, which was however clear of them in September.

No ants were observed; but high up among the grass and rocks of the Lungmo-chhe, at an altitude of about 17,500 feet, there were large numbers of millipedes. On our first arrival in the head of the Shaksgam, a number of horse-flies were observed among the transport; these almost certainly came into the valley with the camp. Blue-bottle flies were noticed about the carcase of a dead pony in the upper Yarkand valley at the end of July. With these two exceptions the absence of any kind of fly was very marked; even after a camp had been pitched at one spot in the Lungmo-chhe for nearly a month, no flies had collected on a refuse heap made by the cook, even though this heap contained the entrails of burrhel and snow-cock. In July and August, among patches of grass and flowers in the Lungmo-chhe, a few bumble bees were observed.

The utter barrenness of the Sa Lungpa was most marked. We found one insect in it, and that probably entered with the camp.

Reptiles. Not a single reptile was seen after crossing the Saser pass. The last observed was a lizard near Umlung on June 21, at an altitude of about 14,000 feet, and a few lizards were seen again in this neighbourhood on October 1. Two species were taken by Major Hingston in 1913 in Hunza below 9,000 feet, but none on the Pâmirs.

SECTION B

DETAILED NOTES ON MAMMALS

By Captain F. O. Cave.

PANTHALOPS HODGSONI.—Tibetan Antelope.

There was no divergence from type in colour or form. They had

the usual puffed-out appearance in the face, and two extensive pouches in the groin. At the end of July they still retained their winter coats, which were however falling out in large tufts. They were first seen on the Depsang plains on June 27, a solitary female with a newly-born young being met. A few were observed the following day near the Chip-chap, and a female in the Lungpa Ngonpo on the 29th. Both males and females were met on June 30 in the Yarkand Amphitheatre, above 16,000 feet, but it was noticeable that they were living apart. The bucks at this time were in the neighbourhood of Hayward's Lake, and the females, sometimes in herds of as many as thirty, were near the source of the Shaksgam by pass "G", and in the tributaries and open stretches of the upper valley "B".

Antelope were again found about eight miles up the Lungmo-chhe, whither they had obviously strayed from the Yarkand river. But none, and no traces of any, were found below the gorge of valley "H", in the upper Shaksgam valley, in the headwaters of the Lungmo-chhe, or in the Sa Lungpa.

It was therefore somewhat surprising to find females with young in August on the Aghil Depsang—an interesting case of ecology, for the altitude and surroundings are here almost identical with those on the Depsang plains. A male and a female were seen in the "Low Col Stream" valley, a tributary to "J", which I explored with Clifford during the same month. This points to the probability that valley "J" is their route to the Aghil Depsang; and if this is so, there must be more vegetation here than Colonel Wood supposed.

By the middle of September, it was apparent that the numbers of antelope in the Yarkand basin were diminishing, and from the direction that observed animals were taking, it is probable that they were migrating eastwards. A few appeared to be moving up the Lungpa Ngonpo towards the Karakoram pass.

Several specimens of both male and female were obtained for food. The biggest head seen was probably between 25 and 26 inches, the largest shot was 24½ inches, and several over 23 inches were obtained.

On one occasion, the first bullet fired at an antelope shattered a 23½-inch horn about five inches from the tip. The antelope remained standing, completely still and apparently dazed, at three hundred yards range. The second and third shots missed, and still he remained motionless. The fourth killed him. Antlered animals such as stags are not stunned in this way, for the antler is not a definite part of the skull, as is the horn of an antelope.

OVIS NAURA.—Burrhel.

Burrhel were fairly numerous. There was no divergence in colour or form from type. A few were seen west of the Saser pass and in the Burtsa valley south of the Depsang, but none on these plains themselves or in the Chipchap, Karakoram pass valley, or the Lungpa Ngonpo. Small herds were seen in the Shaksgam basin near

the Kyagar Thso ; these contained only females and young. Their favourite haunts appeared to be the side nala of the Lungmo-chhe, and a few were seen in the lesser tributaries on the left bank of the Yarkand river. They were also met in the Kalmuk Lungpa tributary of the Zug-Shaksgam, and traces of them in this main valley itself. They probably extend down the Shaksgam along the northern valleys of the Karakoram range as far as Hunza. Large accumulations of droppings were found in the Lungmo-chhe, generally in caves or very sheltered ravines, and from this observation it seems possible that this valley is a wintering ground for them.

Several specimens were obtained for food. The animals were not shy, and therefore not difficult to stalk. The largest head shot was 28½ inches, and several heads about this size were seen. A number of dead heads lay about in the Lungmo-chhe, the largest being 35 inches, which is believed to be a record.

CAPRA SIBIRICA.—Ibex.

Ibex were observed near Umlung west of the Saser pass on 1st October ; the young were very tame. The males had probably been driven higher by constant caravan traffic. No ibex were seen beyond the Saser pass nor in the Shaksgam or Yarkand river basins.

EQUUS HEMIONUS.—Kyang.

A small herd of kyang was seen in the Lungmo-chhe about the middle of July. Vast quantities of droppings were found all over the Amphitheatre, in the Yarkand valley, and in the Lungmo-chhe. There were many well-defined paths made by these animals in these valleys, which were heavily trodden down ; by following these paths, any obstacles, such as cliffs or gorges, could be circumvented. In the middle of July some of the tracks and droppings were so recent that it seemed that the kyang must have vacated the neighbourhood a very few days previously. Tracks not more than a day old were found in valley "M", a tributary on the right bank of the Yarkand river, in the middle of September. No kyang were shot.

BOS GRUNNIENS.—Wild Yak.

Droppings were found in the Amphitheatre, Yarkand valley and Lungmo-chhe, and to a lesser extent in the "Low Col Stream" tributary of valley "J". These droppings were widely distributed and were in every stage of decomposition. This fact indicates that yak are to be found here at frequent, and possibly at annual intervals. It is very unlikely that the droppings were those of animals driven here by Khirgiz, for there was not a single fireplace and no other signs of human incursion. Two yak heads were picked up in the Yarkand valley, but no wild yak were actually seen.

CANIS LUPUS.—Wolf.

The pug-marks of wolves were observed, particularly in the Lungmo-chhe, but no animals were seen away from the caravan route. The tracks of five wolves were seen following a herd of antelope up valley "M" in September. It seems possible that these animals only invade the area when other animals are migrating through it, or when these others are present in larger numbers than at the time of our visit.

FELIS ISABELLINA.—Lynx.

Pug-marks, believed to be those of lynx, were found, mainly in the Lungmo-chhe. In some cliffs in the Yarkand valley cats of some species were heard mewing; these were suspected from neighbouring marks to be lynx.

FELIS UNCIA.—Snow Leopard.

Pug-marks, suspected to be those of snow leopard, were observed in two places.

SMALLER MAMMALS

HARES were very common throughout the Lungmo-chhe and to a lesser extent in the Yarkand valley downstream of Hayward's Lake. They appeared to be similar to those found in Ladakh.

MICE similar to those seen in Ladakh, with short stumpy tails were abundant in the Lungmo-chhe.

MOUSE-HARES also similar to those of Ladakh were abundant in the Lungmo-chhe and Yarkand valley; they were seen at about 14,500 feet in the Kalmuk Lungpa. They lived under rocks and boulders, always close to water. On one occasion one was seen to be seized and carried off by an eagle.

A few STONE-MARTINS were seen in the Lungmo-chhe.

SECTION C**CAPTAIN CAVE'S COLLECTION AND OBSERVATIONS
OF BIRDS**

By Hugh Whistler, F.L.S., F.Z.S.

It was arranged that during the expedition Captain Cave should endeavour to record notes on all birds met with, and to collect a specimen of every one when possible. He had no previous training as an ornithologist, but he threw himself into the task with enthusiasm, and recorded very careful daily notes on all the birds met, from June 16 when the Khardung pass was crossed on the outward journey, to October 9 when the same pass was reached on the return.

A collection of 56 skins was also made to assist in the correct identification of the birds, about which notes had been recorded. In the list that follows, abstracts are given of these notes, and the skins collected are listed under the respective species.

No new species or race was procured. The most interesting bird obtained was undoubtedly the specimen of the Dusky Willow-Wren, *Phylloscopus fuscatus*, which was a long way out of its known range. For the rest, the birds obtained or noticed were very much what were to be anticipated, though a few birds, which might have been expected, are missing from the list. These may well have escaped the notice of a party whose professed object was not ornithological. The notes however contain many points of interest regarding migration, and the great altitudes at which many of the migrants were found resting, probably constitute records of their kind.

Most of the collecting was done in the country comprising the headwaters of the Yarkand river. As has been said in the opening part of this chapter, the country is extremely elevated and barren, and the expedition did not descend below 15,000 feet from the middle of June to the end of September, even in the bottoms of the valleys except in the Zug-Shaksgam where very few birds were observed. For the greater part of that time, camps were at elevations of 16,000 and 17,000 feet.

After the Nubra valley is passed and its cultivation and villages, boggy swamps and small copses of stunted trees are left behind, few localities can be recommended to an ornithologist. The most interesting is undoubtedly Hayward's Lake, which would probably be worth a prolonged visit during the period of migration. Skyangpo-chhe, below the Saser La, and parts of the Lungmo-chhe should also be worth working thoroughly.

I have to thank Dr Claud B. Ticehurst for assisting me in the identification of the skins obtained. Many of the "sight records" in Captain Cave's notes have not been accepted for the purposes of this report, but those included here appear to have been correct.

LIST OF BIRDS

1. CORVUS CORAX TIBETANUS Hodgson.—Tibetan Raven.

This fine bird was noted practically daily throughout the expedition, from the Khardung pass, along the Nubra valley, across the Depsang plains, and in the whole area about the Shaksgam and Yarkand rivers at altitudes from 10,200 to 17,600. As many as eight were recorded together on two occasions, once when they were feeding on a dead pony.

2. *PICA PICA BACTRIANA* BONAP.—Kashmir Magpie.

Very common in the Shyok and Nubra valleys from Khardüng to Pānāmik, at altitudes from 10,200 to 11,000, on both journeys in June and October.

3. *PYRRHOCORAX PYRRHOCORAX* (LINNÆUS).—Red-billed Chough.

As usual, the distribution of the Red-billed Chough was found to be very difficult to understand. From the Khardüng pass to Murgo, they were met with on both journeys here and there at altitudes from 10,500 to 15,800 feet. Otherwise they were only observed in the Lungmo-chhe at 16,400. Here a small party was seen on September 5, and on the following day they were very numerous in flocks up to about thirty in number.

4. *PYRRHOCORAX GRACULUS* (LINNÆUS).—Yellow-billed Chough.

A few were noted on both journeys in June and October between Khardüng and Skyangpo-chhe from 11,500 to 15,800. Otherwise they were not seen beyond the Saser La, except possibly in two very doubtful instances at the Kyagar Thso, Upper Shaksgam, on July 8 and 9.

5. *TICHODROMA MURARIA* (LINNÆUS).—Wall Creeper.

One was seen at Umlung, 13,250 feet, on June 21. It spent much time by the river bed, and flew up high amongst the cliffs.

6. *ENANTHE DESERTI OREOPHILA* OBERHOLSER.—Tibetan Desert Wheatear.

Col. No. 32. ♀ 28-8-26. Upper Lungmo-chhe, 16,600.

Col. No. 48. ♂ 23-9-26. Hayward's Lake, 16,800.

A few were noted between July 21 and September 16 about the Yarkand river and the Lungmo-chhe at elevations of from 15,400 to 16,800 feet. It was also reported as common at Hayward's Lake, 16,400, on September 23, and at Chong-tash, 15,200, on September 30. It was noted on October 7 near Tegur, 10,200, Nubra valley.

7. *PHENICURUS ERYTHROGASTRA GRANDIS* (GOULD).—Guldenstadt's Redstart.

Col. No. 9. ♂ 23-6-26. Skyangpo-chhe, 15,800.

Col. No. 12. ♀ 15-7-26. Upper Shaksgam, 16,000.

Col. No. 20. ♂ 26-7-26. Upper Lungmo-chhe, 16,000.

Col. No. 21. ♂ juv. 26-7-26. Upper Lungmo-chhe, 16,400.

This handsome bird was not noticed on the outward journey until Umlung, 13,250, was reached on June 21. From there onwards, it was found to be one of the commonest birds, and was noted almost everywhere at heights from 15,000 to 17,500 feet in July, August and September. On the return journey, in the first

week of October, it was common from the Nubra valley to the Khardüng stream, 10,200 to 15,000 feet. Young birds were first seen on the wing about July 17.

8. *CYANOSYLVIA SVECICA ABBOTTI* (RICHMOND).—Kashmir Blue-throat.

Col. No. 5. ♂ 26-6-26. Pānāmik, 10,400.

Fairly common and doubtless breeding in watery fields with thorn scrub round Pānāmik in June.

9. *CYANOSYLVIA SVECICA PALLIDOGULARIS* (SARUDNY).—Eastern Red-spotted Blue-Throat.

Col. No. 53. ♂ 29-9-26. Murgo, 14,800.

A single male seen and shot at Murgo proves to be of this race; it was doubtless on migration. Two male Blue-throats were shot at Pānāmik on October 5-6, but as they were not preserved, the race remains in doubt.

10. *MONTICOLA SOLITARIA PANDOO* (SYKES).—Blue Rock-Thrush.

Col. No. 55. ♀ 7-10-26. Junction of Shyok and Nubra, 10,100. A single bird shot in thorn scrub.

11. *MONTICOLA SAXATILIS* (LINNÆUS).—Rock-Thrush.

Col. No. 28. ♀ juv. 22-8-26. Upper Lungmo-chhe, 16,800. Believed to have been seen on one or two other occasions.

12. *PRUNELLA RUBECULOIDES* (MOORE).—Robin Accentor.

Col. No. 7. ♂ ad. 23-6-26. Skyangpo-chhe, 15,700.

A few were observed on both journeys between Khardüng and Skyangpo-chhe between 10,400 and 15,800 feet. They were generally seen on bare hillsides just below the snowline.

13. *PRUNELLA FULVESCENS FULVESCENS* (SEVERTZOV).—Brown Accentor.

Col. No. 56. ♂ 6-10-26. Nubra Valley, 10,200.

On the return journey from October 5-9, it was found to be fairly common in the Nubra and Shyok valleys from Pānāmik to Khardüng at elevations from 10,200 to 18,500. It had not been noticed there in June.

14. *SYLVIA COMMUNIS ICTEROPS* (MENETR).—Eastern Whitethroat.

Col. No. 30. ♂ 28-8-26. Upper Lungmo-chhe, 16,400.

Col. No. 39. ♂ 4-9-26. Upper Lungmo-chhe, 16,800.

A few were observed in the Lungmo-chhe, up a small tributary of the Yarkand river, and at Hayward's Lake, between August 28 and September 28, at altitudes from 15,300 to 16,800 feet. These

birds were of course on migration like the birds obtained by Biddulph and Scully in Gilgit. This Whitethroat is one of the few species which pass through the plains of North-west India (Sind, Punjab, Kohat, Mount Abu, Deesa) from August to October to take the Arabian route to their winter quarters out of India.

15. *SYLVIA CURRUCA AFFINIS* (BLYTH).—Indian Lesser Whitethroat.

Col. No. 44. ♂ 16-9-26. Tributary of Yārkand river, 15,300.

Several were seen when the specimen was shot. They were on migration.

16. *PHYLLOSCOPUS COLLYBITUS SINDIANUS* BROOKS.—Sind Willow-Wren.

Col. No. 54. sex? 5-10-26. Pānāmik 10,400.

Apparently common in the hedgerows of the Nubra-Shyok valleys in June and October.

17. *PHYLLOSCOPUS FUSCATUS* (BLYTH).—Dusky Willow-Wren.

Col. No. 17. ♀ 23-7-26. Hayward's Lake, 16,300.

A single specimen seen and shot at Hayward's Lake, where it was thought to be nesting in a hole in a crumbling bank. This is the most interesting bird obtained by the expedition, as it extends the known range of the species to a considerable extent, its range in the breeding season being given as Siberia from the Yenesei to Ochotsk, North China, Mongolia and Japan. The winter range includes North-east India, and as far west as Etawah.

18. *LEPTOPECILE SOPHIAE SOPHIAE* SEVERTZOV.—Stoliczka's Warbler-Tit.

Col. No. 6. ♂ 21-6-26. Pānāmik, 10,500.

Organs enlarged. Three were seen in thorn scrub near Pānāmik. There are only three other records for Ladākh.

19. *STURNUS VULGARIS PORPHYRONOTUS* SHARPE.—Central-Asian Starling.

Col. No. 19. ♀? 27-7-26. Upper Lungmo-chhe, 18,000.

This starling was picked up dead and frozen on the snow in the Lungmo-chhe, and provides apparently the highest known altitudinal record for the species. The bird of course must have been a casualty from a migrating flock and there is nothing to show how long it had been lying amidst the snows. The date is too early for the bird to have been on the autumn passage of 1926. It was preserved in spirit, and after soaking it in hot water for about an hour, I had the unusual experience of skinning in Sussex a bird killed in the Karakoram.

20. *CARPODACUS ERYTHRINUS* (PALLAS).—Common Rose-Finch.
Col. No. 31. ♂ 28-8-26. Upper Lungmo-chhe, 16,400.
Col. No. 52. ♂ 30-9-26. Saser Brangsa, 15,000.
Also observed in a gorge near Murgo, 14,800, on September 29.
21. *ACANTHIS FLAVIROSTRIS LADACENSIS* MEINERTZHAGEN.—Ladakh Twite.
Col. No. 2. ♀ 16-6-26. Between Khardung and the Shyok river, 11300. Shot in thorn scrub on a stony hillside.
22. *SERINUS PUSILLUS* (PALLAS).—Gold-fronted Serin.
Col. No. 1. ♂ 15-6-26. Khardung, 13,200.
Noted as common on stony hillsides near water.
23. *FRINGILLAUDA BRANDTI BRANDTI* (BONAPARTE).—Brandt's Mountain Finch.
Col. No. 8. ♂ 26-6-26. Murgo, 14,800.
Col. No. 15. ♀ 17-7-26. Upper Shaksgam, 16,000.
Col. No. 38. ♂ juv. 28-8-26. Upper Lungmo-chhe.
First recorded at Skyangpo-chhe, 15,500, on June 23. From then onwards till the middle of September they were found to be very common everywhere at 16,000 to 17,500, and were noted almost daily. They were generally in flocks which were rather shy and kept to absolutely bare open hillsides. Young birds were not seen on the wing until well on in August. In September they were found to have left the Yarkand river and Hayward's Lake, where they had been common in July.
24. *EMBERIZA ICTERICA EVERSM.*—Red-headed Bunting.
Col. No. 43. ♂? imm. 16-9-26. Tributary of Yarkand river, 15,300.
A single straggler, the only one seen. These birds arrive in Sind at the end of August and have again passed on from there by the third week in September, so this bird must have been a lost migrant. Scully similarly obtained a single immature bird of the closely allied species *E. melanocephala* Scopoli at Gilgit on September 17. (*Stray Feathers*, x. 181).
25. *RIPARIA RUPESTRIS* (SCOPOLI).—Crag Martin.
Martins doubtless of this species were very numerous between Khardung and Khalsar at 12,000 on June 16, and some were seen on the way to Tegur next day. A few were seen by the Khardung stream, 12,000, on October 8.
26. *CHALIDON* sp?—Martin.
Some species of Martin was very numerous about crumbling

cliffs between Khardüng and Khalsar, 12,000, on June 16. Others were noted near Pānāmik, 10,500, on June 21, and near Umlung, 13,700, on June 23.

27. *HIERUNDO RUSTICA LINNAEUS*.—Swallow.

Noted from Tegur to Pānāmik, 10,400, on June 18-19.

28. *MOTACILLA ALBA PERSONATA GOULD*.—Masked Wagtail.

Col. No. 29. ♂? 28-8-26. Upper Lungmo-chhe, 16,400.

Col. No. 37. ♂? 29-8-26. Depot camp, Lungmo-chhe, 16,800.

Some form of white wagtail was observed from Khardüng to Tegur on June 16-17, about 10,000-11,000. Otherwise this species was only noted from August 23 onwards, when a fair number were seen in the Lungmo-chhe, on the Yārkand river, and in other localities, doubtless on migration. They were very common at Hayward's Lake, 16,400, on September 23. The highest record is for August 23, when one was seen flying across the middle of the Marpo La glacier at 18,100 feet. The records probably refer to more than one race, but the only two specimens preserved belong to *M.a.personata*.

29. *MOTACILLA CINEREA CASPICA (GMELIN)*.—Eastern Grey Wagtail.

Col. No. 51. sex? 29-9-26. Mурго, 14,800. Tail 90 mm.

30. *MOTACILLA FLAVA BEEMA SYKES*.—Indian Blue-headed Wagtail.

Col. No. 14. ♂ 17-7-26. Upper Shaksgam, 16,000.

Col. No. 49. ♀ 23-9-26. Hayward's Lake, 16,400.

No. 14 was a solitary bird shot by a pool of water. Wagtails of this type were numerous on the Yārkand river, 15,300, on September 15-16, and about Hayward's Lake on September 23, of course on migration.

31. *MOTACILLA CITREOLA CALCARATA (HODGSON)*.—Hodgson's Yellow headed Wagtail.

Col. No. 4. ♂ 18-6-26. Pānāmik, 10,600. Organs very large.

Col. No. 26. Juv. 16-8-26. Upper Lungmo-chhe, 16,400.

Col. No. 40. ♀ Juv. 5-9-26. Upper Lungmo-chhe, 16,400.

A few were apparently breeding about Pānāmik on June 18-20. They were also observed in small numbers on the Lungmo-chhe, Yārkand river and in other localities on the return journey. The only place where they seemed to be numerous was at Hayward's Lake, 16,400, on September 23.

32. *ANTHUS TRIVIALIS L.*.—Tree Pipit.

Col. No. 41. ♂ 5-9-26. Upper Lungmo-chhe, 16,400.

Col. No. 42. sex? 7-9-26. Upper Lungmo-chhe, 16,400.

Observed on migration frequenting wet ground. No. 41 was a solitary bird, while No. 42 was one of three. In the Lower Lungmo-chhe, 15,500, four were seen on September 15 and one the next day. A pipit, believed to be of this species, was common at Hayward's Lake, 16,400, on September 23, and at Pānāmik, 10,400, on October 5. Both specimens apparently belong to the typical race.

33. *Otocoris alpestris longirostris* (MOORE).—Long-billed Horned-Lark.

Col. No. 3. ♂ 16-6-26. Khardüng, 13,350.

Col. No. 24. ♂ 26-7-26. Lower Lungmo-chhe, 16,000.

The organs of both these specimens were much enlarged.

34. *Otocoris elwesi Blanford*.—Elwes' Horned Lark.

Col. No. 10. ♀ juv. 28-6-26. Chip-chap R., Daulat-Beg-öldi, 16,400.

Col. No. 11. ♀ 28-6-26. Five miles SE of Karakoram pass, 17,200, with c/2 incub. eggs.

Col. No. 23. juv. 26-7-26. Lower Lungmo-chhe, 16,000.

Col. No. 25. juv. 4-8-26. Middle Lungmo-chhe, 16,400.

Col. No. 27. ♀ 16-8-26. Upper Lungmo-chhe, 16,300.
Slight incubation patch.

Col. No. 33. ♀ 28-8-26, Upper Lungmo-chhe, 16,400.
Slight incubation patch.

Col. No. 34. ♂ juv. 28-8-26. Upper Lungmo-chhe, 16,400.

Col. No. 35. ♂ juv. 28-8-26. Upper Lungmo-chhe, 16,400.

Col. No. 36. juv. 28-8-26. Upper Lungmo-chhe, 16,400.

Horned Larks were met with on the Khardüng pass, 13,350. After that they were next observed at Skyangpo-chhe, 15,200, and were found to be very common over all the ground traversed by the expedition north of that place at altitudes from 14,800 to 17,500. The nest found was composed of dry mud with an inner layer of dried grass and a lining of numdah felt and strips of native cloth.

Eleven specimens were preserved as enumerated above, and we find here, as in many other localities, the curious intermixture of two forms, which renders the study of these birds so difficult. Some very careful collecting will have to be done over wide areas of the Central-Asian Highlands before the number of good forms and their distribution can be worked out.

The juvenile of *elwesi* is not, as stated in the second edition of the Fauna B. I. Birds, similar to that of *longirostris*. It is very distinct. Above it is much paler, being more sandy-yellow in tint, while the wing and tail feathers are also paler—rufous brown as opposed to dark brown. The chin, throat and breast are more

markedly tinged with canary yellow. Captain Cave's series of juveniles of *elwesi* is very different to my own series of juvenile *longirostris* collected in Lahūl, where only that form occurs.

35. *UPUPA EPOPS* L.—Hoopoe.

Col. No. 18. ♀ 27-7-26. Upper Lungmo-chhe, 16,500.

Hoopoes were seen between Khalsar and Tegur, 10,100, on June 17, and at Pānāmik on June 19-20. Single birds were seen at 16,400 and 17,200 in the Lungmo-chhe on July 27.

From August 7 to September 12 a few were noted in the Lungmo-chhe, between 15,900 and 16,400 feet. In August one was seen in the Sa Lungpa at 16,200, and one in the Zug-Shaksgam at 14,200. The first of these two, which walked into an occupied tent, and fearlessly hunted for food, was recorded as the only living thing seen in that valley except one insect.

Single birds were seen on September 15 on a small tributary of the Yārkand river at 15,300, on September 16-17 on the Yārkand river at 15,500, and on September 30 at Chong-tāsh, 15,200.

Scully met a Hoopoe on the Depsang on September 14. (*Stray Feathers* iv. 51) and at over 18,000 by the Karakoram Pass on September 16. These records are however overshadowed by that of 21,000 for the first Everest Expedition. (*Ibis*. 1922 p. 504).

36. *MICROPIUS SP?*—Swift.

Noted from Khardūng to Pānāmik, from June 16-21.

37. *CUCULUS CANORUS* L.—Cuckoo.

Col. No. 22. ♂ juv. 29-7-26. Head of Lungmo-chhe, 17,200.

The above specimen was found perched on a rock just outside the camp at 17,200. This must be one of the highest records for the species.

38. *GYPAETUS BARBATUS* (L).—Lammergeier.

Large birds seen on July 20 in the Upper Shaksgam, 16,800, and on September 27 at Kizil Langar, 16,000, and a bird that was constantly seen in August about one particular locality in the Lungmo-chhe, 16,000, appear to have been Lammergeiers.

39. *CIRCUS AERUGINOSUS* (L).—Marsh Harrier.

Col. No. 45. ♂ 23-9-26. Hayward's Lake, 16,400.

This specimen was found feeding on a dead "Blue Heron".

A few other birds of prey were observed by the expedition, but specimens could not be obtained. Kestrels were noticed, and in the Lungmo-chhe the camp was occasionally visited by birds which from the description seem to have been the Black-eared Kite (*Milvus lineatus*).

40. *COLUMBA LEUCONOTA* VIGORS.—Snow Pigeon.

The snow pigeon, according to Capt. Cave, was met with commonly throughout the greater part of the country traversed by the expedition north of the Khardūng pass at altitudes from 10,000 to 17,500 feet. He probably however failed to notice the fact that two species of Pigeon are common at high altitudes, as Scully observed the Blue Hill Pigeon (*columba rupestris*) from Khardūng to the Karakoram Pass.

41. *SYRRHAPTES TIBETANUS* GOULD.—Tibetan Sandgrouse.

This bird was noted on June 28 at the Chip-chap river at 16,400, and on July 25 in the Lungmo-chhe at 15,300.

Several were found in mid-August on the Aghil Depsang, 17,500, where they were in parties of seven or eight birds that lay close until approached within a few feet. They were seen to be feeding on a kind of green moss. Fifteen in all were killed for food. A careful sketch and the preservation of two tail feathers have amply served for identification.

42. *ALECTORIS GRECCA PALLESCENS* HUME.—Chukor.

Chukor presumably of this form were met with by the expedition on its passage of the Nubra and Shyok valleys in June and October; they were not met north of this area or above the height of 13,500.

43. *TETRAOGALLUS TIBETANUS* GOULD.—Tibetan Snowcock.

Snowcock, apparently of this species, were very abundant in the Lungmo-chhe between 15,500 and 16,500, every little side valley having its family or two. At the end of July newly hatched broods were common and some of these were able to fly by August 9. By early September the young were nearly as large as their parents and preferred flying to running when disturbed. The broods averaged about ten chicks and on September 15 about thirty were seen in one flock.

Out of the Lungmo-chhe, snowcock were scarce, but some were seen on July 3 in the Upper Shaksgam, 17,800, and in the Kalmuk Lungpa, 15,000-16,000, in August.

It was definitely noted that these snowcock were paler and greyer than the ordinary snowcock found about Leh, and that they lacked the white wing-patch of the latter.

44. *VANELLUS VANELLUS* (L.).—Lapwing.

A single bird was seen and shot at Pānāmik, 10,400, on October 4.

45. *IBIDORHYNCHA STRUTHERSII* VIGORS.—Ibis-bill.

Seen on June 17 near the junction of the Shyok and Nubra rivers, 10,100,

46. *TRINGA HYPOLEUCA* L.—Common Sandpiper.

Three birds seen on July 24 at 16,000 on the Yarkand river were apparently of this species.

47. *TRINGA OCHROPIUS* L.—Green Sandpiper.

Col. No. 13. ♀ ad. 15-7-26. Upper Shaksgam, 16,000. Four seen.

48. *EROLIA MINUTA* (LEISLER).—Little Stint.

Col. No. 16. ♀ ad. 23-7-26. Hayward's Lake, 16,400.

49. *EROLIA TEMMINCKII* (LEISLER).—Temminck's Stint

Col. No. 50. imm. 29-9-26. Murgo, 14,800.

50. *EROLIA FERRUGINEA* (BRUNNICH).—Curlew-Sandpiper.

Col. No. 47. ♂ imm. 23-9-26. Hayward's Lake, 16,400.

Small waders were found to be fairly common on migration at great altitudes and the above four species are represented in the collection of skins. They were first observed on July 15 at 16,000 in the upper Shaksgam, when a bird shot from a party of four proved to be a Green Sandpiper.

From then onwards waders were observed at Kyagar Thso, 15,850; Upper Shaksgam, 17,000; Hayward's Lake, 16,400, (July 22-23, many; September 23, many); Lungmo-chhe, 16,400-17,500, (July 27 August 27, several); Marpo La, 17,600, (August 24: two on a pool formed by a moraine); Lungpa Ngonpa, 16,600; and Chong-tash, 15,200.

A wader shot on July 17 at Tegur, 10,100 was too damaged to skin, but its description reads like that of a Ring Plover (*C. hiaticula*).

51. *PHILOMACHUS PUGNAX* (L.).—Ruff.

Col. No. 46. ♂ imm. 23-9-26. Hayward's Lake, 16,400.

The above specimen was shot from a party of about six. Two or three more were seen at Pānāmik, 10,400, October 4-6, and perhaps two more near Tegur, 10,200, on October 7.

52. *CAPELLA GALLINAGO* (L.).—Common Snipe.

Two were seen at Hayward's Lake, 16,400, on September 23.

53. *ARDEA CINerea* L.—Heron.

Four were seen at Hayward's Lake, 16,800, on September 23, and a dead one was also noticed, on which a Marsh Harrier was feeding. (See No. 39).

54. *CASARCA FERRUGINEA* (PALLAS).—Ruddy Sheldrake.

Twelve were seen at Chong-tash, 15,800, on June 25; one was

shot. Two were seen on Hayward's Lake, 16,400, on June 29-30, and there were about nine at the same place on July 22-23.

55. *ANAS PLATYRHYNCHA* L.—Mallard.

Two were seen and one of them was shot at Hayward's Lake, 16,400, on July 22. Several were seen in the same place on September 23.

56. *CHAULELASMUS STREPENS* (L.)—Gadwall.

A single Gadwall was seen and shot at Chong-tāsh, 15,000, on June 25. Two were seen at Hayward's Lake, 16,400, on September 23.

57. *NETTION CRECCA* (L).—Common Teal.

Single birds were seen on ice-patches at 16,600-16,700 feet in the Lungmo-chhe on August 7 and September 3. Several were seen, and five shot at Hayward's Lake, 16,400, on September 23. One was seen at Pānāmik, 10,400, on October 5.

58. *DAFILA ACUTA* (L).—Pintail

About fifty were seen at Hayward's Lake, 16,400, on September 23, and six in the same place the next day. One was shot each day.

59. *MERGANSER MEGANSER* (Gould).—Goosander.

It seems probable that to this species should be attributed two ducks with a brood of eight ducklings which were seen at Hayward's Lake, 16,400, on July 22-23. Other birds seen in the Shaksgam, 16,000, on July 15, and in the Lungmo-chhe, 16,400, on August 17, were also probably of this species.

SECTION D BUTTERFLIES

Observed and collected by Major H. D. Minchinton. Identified
. by Brigadier W. H. Evans, C.I.E., D.S.O., R.E.

The season was a late one for butterflies, owing to the late falls of snow, and therefore, when the expedition left Leh in June very few butterflies had made their appearance. Only one specimen of the "Blues" was seen here. The Shyok and Nubra valleys were also traversed before the summer butterflies appeared, but a few early "Blues" were caught in the latter. From Pānāmik to the basin of the Yārkand river there were two snowstorms, and the weather was still too cold and the vegetation still too scanty for butterflies; these conditions remained during July in the head basin of the Shaksgam.

It was not till the end of this month, when the Lungmo-chhe was reached, that vegetation was more abundant and several species of butterflies were seen. An entirely blank ten days followed in the inhospitable Sa Lungpa, probably the most barren region on the globe for insect life.

The Aghil Depsang and Tatar Lungpa were almost as barren, but towards the end of August, at the comparatively low elevation of 14,000 feet, more vegetation was encountered in the Kalmuk Lungpa and Zug-Shaksgam. Here two species were caught, a large White and the Painted Lady. The larvae of the latter were feeding on a small pea-like plant.

The beginning of September brought the brief autumn, with increasing cold, and from the time the expedition left the Lungmo-chhe in this month, until it reached Pānāmik on October 3, not a single butterfly was seen.

The collection is therefore exceedingly small, only fifteen species being represented. It is of course probable that a few species were missed, for winged insects have the advantage over man at high elevations.

The Painted Lady was the commonest butterfly observed throughout the expedition. It was observed on one occasion at an altitude of 20,000 feet, and on another in a moraine trough of the Kyagar glacier at nearly 17,000 feet. Various varieties of Whites were next in order of rarity. Blues were only found in four localities; at Tegur and at Pānāmik in the Nubra valley, near pass "G", and at one spot in the Lungmo-chhe. In each place they seemed to be confined to areas of a few square yards only. Clouded Yellows were only seen twice: on a small grassy patch on the hillside in the upper regions of the Shaksgam, and by a side stream in the Lungmo-chhe.

I am indebted to Brigadier W. H. Evans for the following identifications.

LIST OF BUTTERFLIES

1. **PAPILIO MACHAON ASIATICA, MEN.** 1 ♂.

Tails short and referable to var. *ladakensis*, *M.*

Near Murgo, 15,000 feet, 25-6-26.

This was the only occasion that the Swallow-tail was seen for certain.

2. **BALTIA SHAWI, BATES.** 6 ♂. 1 ♀.

Specimens were obtained between Kizil Langar and Depsang plains, 15,000-18,000 feet, 27-6-26; on the Depsang plains, 16,400, 28-6-26; near the Karakoram pass, 17,500, 20-6-26; and on and just NW of pass "G", 17,700 to 18,000, 2-7-26.

3. *BALTIA BUTLERI*, MOORE. 2 ♂. 2 ♀.

Rather local between Kizil Langar and Depsang plains, 16,000, 27-6-26.

4. *PIERIS CALLIDICE KALORA*, MOORE. 1 ♀.

Close to Leh Polu, 14,600, 11-6-26. Not obtained in Shaks-gam region.

5. *PIERIS DAPLIDICE MOOREI*, ROBER. 1 ♂.

Leh, 11,500 4-6-26.

6. *PIERIS DEOTA*, DE NICEVILLE. 2 ♂. 1 ♀.

In gorge below Khardüng village, 11,000, 16-6-26; Pānāmik, 10,200, 20-6-26; Zug-Shaksgam, 14,200, 22-8-26.

7. *PIERIS BRASSICAE*, LINNÆUS. 1 ♂.

Near Kargil, 10,000, 20-5-26.

8. *PIERIS RAPAE*, LINNÆUS. 1 ♀.

Khalatse, Indus valley, 10,000, 24-5-26..

9. *COLIAS STOLICZKANA STOLICZKANA*, MOORE. 4 ♂. 2 ♀.

Valley "H", Shaksgam Valley, above Depot Camp, 16,400, 3-7-26; Middle Lungmo-chhe, 16,800, 24-6-26.

Both very local, and seen nowhere else.

10. *VANESSA CARDUI*, LINNÆUS. 1 ♂.

This specimen of the Painted Lady was obtained on the Aghil Depsang, 17,200, 8-7-26. It was the commonest butterfly seen on the expedition.

11. *VANESSA INTERPOSITA*, STAUDINGER. 3 ♂.

The three specimens of this Tortoiseshell came from the Sind valley and Drās, between 8,000 and 10,000 feet between 14th and 19th May.

12. *VANESSA URTICAE EIZANA*, MOORE. 3 ♂.

Leh Polu, 15,100, 10-6-26; North of Khardüng La, 14,000, 15-6-26.

This butterfly was probably seen in the Lungmo-chhe at the end of July, but no specimen was caught.

13. *LYCAENA CHRISTOPHI SAMUDRA*, MOORE. 4 ♂. 1 ♀.

Shyok-Nubra junction, 10,000, 17-6-26; Pānāmik, 10,200, 5-10-26.

14. *POLYOMMATUS EROS STOLICZKANA*, FELDER. 2 ♂.
Pānāmik, 10,200, 20-6-26.
15. *PAMPHILA COMMA DIMILA*, MOORE. 1 ♀.
Aghil Depsang, 17,200, 8-8-26.

CHAPTER XI

FLORA

By C. E. C. FISCHER, Royal Botanic Gardens, Kew.

MAJOR Clifford's collection though small, is interesting because it marks the affinity of this region, which apparently falls in the Indian Empire, with those further north and west. The following species have not been reported hitherto from India.

No. 14. *Viola thianschanica* Max., from Central Asia.

No. 23. *Astragalus Arnoldii* Hemsl. & H. H. W. Pearson,
from Central Asia.

No. 24. *Astragalus zacharensis* Bunge, from Syria and
S. Mongolia.

No. 39. *Lonicera Semenovii* Regel, from Turkistān.

No. 40. *Leontopodium ochroleucum* Bvd., from Turkistān.

No. 42. *Artemisia pamirica* C. Winkl., from Turkistān.

It is interesting also to record *Oxytropis Malloryana* Dunn, (No. 28), a species collected by the late Mr Mallory during the Mount Everest Expedition; a description of this will be published shortly in the *Kew Bulletin*. A few other species also have been recorded only from Tibet. Several are not recorded in the *Flora of British India*, but the majority of the specimens are of plants already collected in tracts of the Indian region adjacent to this.

The following list quotes the *Flora of British India* wherever possible, and gives the geographical distribution of each species as far as is known. A few specimens are too incomplete for determination*.

A. DICOTYLEDONES

I. RANUNCULACEÆ.

1. *Thalictrum alpinum* Linn.

Col. No. 16. N. Khardüng valley, 14,000 ft.

* Practically all the specimens were collected by Major Clifford. Those with doubtful localities were probably collected by Ladakhi porters in the Zug-Shaksgam and Kalmuk Lungpa, at altitudes of from 14,000 to 15,500 ft. Some of those with localities given but which are too incomplete for determination, were collected when not in flower, or immature. This small collection is a very complete record of the Flora met with after leaving Leh. (K.M.)

- F.B.I.* i. 13. Himalaya, 10,000-17,000 ft.; North Alpine and Arctic Regions.
2. *Ranunculus Cymbalariae* Pursh.
Col. No. 5. Leh, Ladakh, 11,000-12,000 ft.
F.B.I. i. 17. W. Tibet & Sikkim, 7,000-17,000 ft.; Persia, Siberia, Arctic and cold temperate N. America, and Cordilleras of S. America.
3. *Ranunculus hirtellus* Royle.
Col. No. 3. Leh, Ladakh, 11,500 ft.
F.B.I. i. 18. Temperate and subalpine W. Himalaya up to 14,000 ft.

II. FUMARIACEÆ.

4. *Corydalis Bowieri* Hemsl.
Collected in Chip-chap river-bed, 17,500 ft.
Distribution:—Kumaun, Tibet, 15,500 ft.

III. CRUCIFERÆ.

5. *Parrya exscapa* Mey.
Col. No. 8. (Shaks.). Kizil Langar and valleys of streams "B" and "F" up to pass "G", 11,000-18,000 ft.
F.B.I. i. 131. West Tibet, 15,000-18,000 ft. Altai. Mts.
6. *Parrya* sp.
Col. No. 12. N. Khardung valley, 14,000 ft.
7. *Cheiranthus himalayensis* Camb.
Col. No. 7. (Shaks.). Valleys of streams "B" and "F" up to pass "G", 16,500-18,000 ft.
F.B.I. i. 132. W. Tibet, 15,000-17,000 ft.
8. *Cheiranthus Stewartii* T. And.
Col. Nos. 54, 59, & 1. (Shaks.). Kizil Langar and streams "A", "B", & "F", up to pass "G", 16,500-17,900 ft.
F.B.I. i. 132. W. Tibet near Ladakh, 15,000-16,500 ft.
9. *Draba alpina* Linn.
Collected at Kizil Langar, 16,500 ft.
F.B.I. i. 142. Alpine Himalaya. 12,000-17,000 ft. Alps of W. Asia, N. Europe, the Rocky Mountains and Arctic Regions.
10. *Cristolea crassifolia* Camb.
Col. No. 23. Khardung Gorge, 11,000-13,500 ft.
F.B.I. i. 154. W. Tibet, 12,000-15,000 ft.
11. *Brassica campestris* Linn.
Col. No. 24. Yarkand valley, 12,000 ft.
F.B.I. i. 156. Cultivated all over the world.

12. *Dilophia salsa* Thoms.

(No information of locality or elevation; probably Kalmuk Lungpa, *circ.* 14,500 ft).

F.B.I. i. 161. Salt marshes in W. Tibet, 12,000-17,000 ft. Tien Shan Mountains.

IV. CAPPARIDACEÆ.

13. *Capparis spinosa* Linn. var. *vulgaris* Hook. f. & T.

Col. No. 39. Nubra valley, (no altitude stated).

F.B.I. i. 173. W. Himālaya and W. Tibet, up to 13,000 ft.; Afghānistān, W. Asia, Europe, N. Africa, Australia, Sandwich Islands.

V. VIOLACEÆ.

14. *Viola thianschanica* Max.

Col. No. 17. N. Khardūng valley, 14,000 ft.

Distribution:— Central Asia.

VI. CARYOPHYLLACEÆ.

15. *Lychnis himalayensis* Edgew.

Col. No. 36. Nubra valley, 10,800 ft.

F.B.I. i. 223. Sikkim, W. Tibet, 11,000-17,000 ft.

16. *Arenaria* sp.

Col. No. 6. Leh, Ladākh, 11,600 ft.

VII. TAMARICACEÆ.

17. *Myricaria germanica* Desv. var. *prostrata* Hook. f. & T.

Collected in Shaksgam valley between 16,000 & 17,000 ft.

F.B.I. i. 250. Temperate and Alpine Himālaya, 10,000-14,000 ft.

18. *Myricaria elegans* Royle.

Col. No. 22. Khardūng gorge from 12,000 ft. down to the Shyok valley.

F.B.I. i. 250. Himālaya from Garhwāl to Ladākh. 6,000-15,000 ft.

VIII. GERANIACEÆ.

19. *Biebersteinia emodi* Jaub. & Spach.

Collected on hillside below Saser glacier, 16,400 ft.

F.B.I. i. 427. Kunāwār and Alpine W. Tibet, 14,000-17,000 ft.

IX. PAPILIONACEÆ.

20. *Medicago sativa* Linn.

Col. No. 37a. Nubra valley, 10,500 ft.

F.B.I. ii. 90. Widely cultivated as a forage plant.

21. *Astragalus strictus* Grah.
 Col. No. 37b. Nubra valley, 10,500 ft.
F.B.I. ii. 124. Alpine Himālaya, 11,000-16,000 ft.
22. *Astragalus multiceps* Wall.
 Col. No. 9. Leh, Ladākh, 11,500 ft.
F.B.I. ii. 134. W. Himālaya, temperate zone, 10,000-12,000 ft.
23. *Astragalus Arnoldii* Hemsl. & H. H. W. Pearson.
 Collected in streams "B" & "F" up to pass "G", 17,000-18,000 ft.
Distribution :—Central Asia.
24. *Astragalus zacharensis* Bunge.
 Col. No. 33. Nubra valley, 10,300 ft.
Distribution :—Syria, S. Mongolia.
25. *Astragalus* sp.
 Col. No. 32. Nubra valley, 10,500 ft.
26. *Oxytropis lapponica* Grah.
 Col. No. 60. Stream "A", Shaksgam valley, 16,700 ft.
F.B.I. ii. 137. W. Himālaya and Sikkim, 9,000-17,000 ft.
 Mountains of Europe & Siberia.
27. *Oxytropis microphylla* DC.
 Col. Nos. 10 & 19. Valley below Karakoram pass at 16,300 ft. and in N. Khardūng valley, 12,000-15,000 ft.
F.B.I. ii. 139. W. Alpine Himālaya and Sikkim, 11,000-16,000 ft.
28. *Oxytropis Malloryana* Dunn.
 Col. No. 14. N. Khardūng valley 15,000 ft.
 Previously found only in Tibet during the Mount Everest Expedition.

X. ROSACEÆ.

29. *Potentilla purpurea* Royle.
 Col. Nos. 48 & 51. Foot of Saser glacier, 16,400 ft.
F.B.I. ii. 347. N.W. Himālaya.
30. *Potentilla anserina* Linn.
 Col. No. 4. Leh, Ladākh, 11,500 ft.
F.B.I. ii. 350. W. Tibet and Kashmir, 7,000-12,000 ft.
 Kāshgar, N. Asia, Persia and westward to the Atlantic, N. America, Australia.
31. *Potentilla Saundersiana* Royle.
 Col. No. 7. Leh, Ladākh, 11,500 ft.
F.B.I. ii. 354. W. Tibet, 15,000-17,000 ft.; Siberia and Arctic latitudes.
32. *Potentilla sericea* Linn.
 Col. No. 47. Nubra valley, 14,300 ft.
F.B.I. ii. 354. W. Tibet, Alpine Himālaya from Kashmir

to Kumaun, 9,000-17,000 ft. Afghānistān to the Caucasus, Armenia, Soongaria, N. China, Temperate N. America.

33. *Rosa Webbiana* Wall.

Col. No. 21 & 31. Nubra valley, 10,500 ft., Khardūng gorge from 12,000 ft. down to the main Shyok valley.

F.B.I. ii. 366. Himālaya from Kashmīr to Kumaun and W. Tibet, 5,000-13,000 ft.

34. *Rosa sericea* Lindl. var.

Col. No. 30. Nubra valley, 10,300 ft.

F.B.I. ii. 367. Temperate Himālaya from Kumaun to Sikkim and Bhutān, 5,000-14,000 ft.; China.

XI. CRASSULACEÆ.

35. *Sedum tibeticum* Hook. f. & T.

Col. Nos. 20 & 58. N. Khardūng and Chip-chap valleys, 17,500 ft.

F.B.I. ii. 418. Alpine W. Himālaya, 12,000-16,000 ft. Kābul.

XII. UMBELLIFERÆ.

36. 37. Col. Nos. 26 & 29. Too defective to be identified.

XIII. CAPRIFOLIACEÆ.

38. *Lonicera spinosa* Jacq. ex Hook. f. & T.

Col. No. 34. Nubra valley, 10,500 ft.

F.B.I. iii. 13. Alpine Himālaya from Kashmir to Sikkim, 11,000-16,000 feet.

39. *Lonicera Semenovii* Regel.

Col. No. 45. Nubra valley, 10,000-16,000 ft.

Distribution:—Turkistān.

XIV. COMPOSITÆ.

40. *Leontopodium ochroleucum* Bvd.

Col. No. 15. N. Khardūng valley, 13,500-15,100 ft.

Distribution:—Turkistān.

41. *Tanacetum tibeticum* Hook. f. & T.

Col. Nos. 12d & 61a. Valley "D" at 16,300 ft., and Depsang plains at 17,600 ft., to Karakoram pass and on.

F.B.I. iii. 319. W. Tibet, 15,000-17,000 ft.

42. *Artemisia pamirica* C. Winkl. or near it.

No place or height given; probably near Zug-Shaksgam, about 14,200 ft.

43. *Senecio goringensis* Hemsl. or near it.

Col. Nos. 13d & 61b. Tributary "D" of Shaksgam valley,
17,000 ft., and valley "A" & Amphitheatre,
16,700-17,300 ft.

Distribution :—Tibet.

44. *Saussurea* sp.

Col. No. 10. No place or elevation given.

45. *Taraxacum dissectum* Ledeb.

Col. No. 18. N. Khardung valley, 14,000 ft.

Distribution :—Siberia.

46. Col. No. 14. Too young to identify.

XV. PRIMULACEÆ.

47. *Androsace Chamaejasme* Hort. var. *coronata* Watt.

Col. Nos. 13 & 15b (Shaks.). Shaksgam valley, 16,500 ft.
F.B.I. iii. 499. W. Tibet, 16,000-17,000 ft.

XVI. GENTIANACEÆ.

48. *Gentiana prostrata* Haencke.

Col. No. 1b. Yarkand valley, 17,000-18,000 ft.

F.B.I. iv. 110. Tibet, Tyrol, Afghanistan, Siberia, Arctic America, and the Cordilleras of S. America.

XVII. BORAGINACEÆ.

49. *Eritrichium spathulatum* C. B. Clarke.

Col. No. 42. Tutyailak, 14,600 ft.

F.B.I. iv. 164. W. Tibet, 16,000 ft:

50. *Arnebia tibetana* Kurz.

Collected in Zug-Shaksgam valley, 14,000-14,500 ft.

F.B.I. iv. 176. N. Kashmir and W. Tibet, 7,000-12,000 ft.
Kashgar, Yarkand.

XVIII. CONVOLVULACEÆ.

51. *Convolvulus arvensis* Linn.

Col. No. 25. Shyok valley, 11,000 ft.

F.B.I. iv. 219. India from Kashmir to the Deccan, a weed of cultivation. Nearly all temperate and sub-tropical regions.

XIX. SCROPHULARIACEÆ.

52. *Lancea tibetica* Hook. f. and T.

Col. No. 1a. Leh, Ladakh, 11,500 ft.

F.B.I. iv. 260. Alpine Himalaya and W. Tibet, 11,000-16,000 ft.

53. *Veronica Anagallis* Linn.

Col. No. 85. Nubra valley, 10,500 ft.

Distribution :—Turkistan.

- F.B.I.* iv. 293. N.W. India, W. Tibet, Bengal, Assam, Deccan, from the plains up to 15,000 ft. Europe, Asia, N. and S. Africa, N. America.
54. *Veronica Beccabunga* Linn.
Col. No. 2. Leh, Lādakh, 11,500 ft.
- F.B.I.* iv. 293. W. Himalaya & W. Tibet, 9,000-12,000 ft.; Afghānistān, Europe, Abyssinia, N. Asia and Japan.

XX. SELAGINACEÆ.

55. *Lagotis decumbens* Rupr.
Col. No. 15a (Shaks.). Shaksgam valley, 17,000-18,000 ft.
- F.B.I.* iv. 559. W. Tibet, Karakoram and Karakāsh Mts. 16,000-18,000 ft.; Tien Shan Mts.

XXI. LABIATÆ.

56. *Nepeta longibracteata* Benth.
Col. No. 6. (Shaks.). Shaksgam valley, 16,500 ft.
- F.B.I.* iv. 660. W. Himalaya & W. Tibet, 14,000-17,000 ft.
57. *Dracocephalum heterophyllum* Benth.
Collected probably in Zug-Shaksgam, 14,200 ft.
- F.B.I.* iv. 665. W. Tibet, 13,000-16,000 ft. Turkistān.
58. Col. No. 8. Unidentified.

XXII. POLYGONACEÆ.

59. *Polygonum viviparum* Linn
Col. No. 28. Shyok valley, 11,000 ft.
- F.B.I.* v. 31. Himalaya from Kashmīr to Sikkim; W. Tibet, 9,000-15,000 ft.; Alpine, North & Arctic Europe, Asia and America.

XXIII. EUPHORBIACEÆ.

60. *Euphorbia tibetica* Boiss.
Col. No. 18. N. Khardūng valley, 12,000-15,000 ft.
- F.B.I.* v. 260. W. Tibet, 10,000-15,000 ft. Kashgar.

XXIV. URTICACEÆ.

61. *Urtica hyperborea* Jacq. ex Wedd.
Col. No. 48. Mamostong glacier stream, 13,500-15,000 ft.
- F.B.I.* v. 548. E. and W. Tibet, 12,000-17,500 ft.

XXV. GNETACEÆ.

62. *Ephedra intermedia* Stapf. var. *tibetica*.
Col. No. 57. Chip-chap valley, 17,500 ft.
- F.B.I.* v. 863. W. Tibet, Afghānistān, Khotan.

B. MONOCOTYLEDONES

XXVI. ORCHIDACEÆ.

63. *Orchis latifolia* Linn.

Col. No. 51. Pānāmik, Nubra valley, 12,000 ft.

F.B.I. vi. 127. W. temperate Himālaya, W. Tibet, 8,000-12,000 ft.; Westward from Afghānistān to N. Africa and the Atlantic, N. Asia.

XXVII. LILIACEÆ.

64. *Allium blandum* Wall

Collected probably in Zug-Shaksgam valley 14,200 ft.

F.B.I. vi. 339. Himālaya from Kumaun to Nepāl, W. Tibet, 13,000-17,000 ft.

65. *Gagea persica* Boiss.

Col. No. 46. Tutyailak, 14,300 ft.

F.B.I. vi. 355. W. Himālaya, 5,000-8,000 ft. westward to Persia, Turkistān.

XXVIII. CYPERACEÆ.

66. *Carex incurva* Lightf.

Col. No. 11. (Shaks.). Shaksgam valley, 15,800 ft.

F.B.I. vi. 700. N.W. Himālaya, Kunāwār and Kashmīr to the Karakoram, 11,000-15,500 ft.

XXIX. GRAMINACEÆ.

67. *Elymus sibiricus* Linn.

Collected in Kalmuk Lungpa, 14,500 feet.

F.B.I. vii. 373. Himālayan region, 10,000-15,000 ft.

Afghānistān, Abyssinia, N. Asia, and N. America.

68. *Agropyrum* sp. near *longiaristatum* Boiss.

Collected probably in Kalmuk Lungpa, about 14,500 ft.

69. *Stipa* sp.

Collected probably in Kalmuk Lungpa, about 14,500 ft.

70. *Poa* sp. near *bulbosa* Linn.

Col. No. 9. (Shaks.). Shaksgam valley, 17,800 ft.

CHAPTER XII

METEOROLOGY

By Captain F. O. CAVE.

AS it was unlikely that the expedition would remain long enough in any one place for a useful series of temperature and pressure observations to be made, and as transport was certain to be limited, it was agreed in consultation with meteorological experts that we should not encumber ourselves with many instruments, but should rather confine ourselves to a daily weather diary. Accordingly the only instruments taken were a sling thermometer and a small nephoscope.

On almost every day when cirrus clouds were in evidence, their direction was observed, fifty-five sets of observation being made. It was most noticeable that cirrus was far more frequent in May and June than in any other month, and that its direction was almost constant from the west or south-west. Indeed, not a single observation was recorded with an easterly direction.

Halo were noted on several occasions. They were frequent with cirrus clouds during the early months of our observations. One elliptical halo was observed on July 31st.

We were asked to observe the behaviour of wind in valleys, with special reference to any regularity *up* or *down* the valleys by day and night. No directional regularity was observed; but it was found that a strong wind often sprang up in the afternoon, particularly on fine days, blowing from the regions of snow and ice on the Muztagh-Karakoram range towards the drier areas in the neighbourhood of the Karakoram pass and the Depsang plains, where there are practically no glaciers or snow. For instance, these winds would blow *up* the Chip-chap river from the Rimo glacier, and *down* the upper Yarkand river from the same locality. Similarly they would blow *up* the Shaksgam from the Teram Kangri and Gasherbrum groups, and down the Lungmo-chhe from the glaciers at the head of this valley. These winds would drop in the evenings, and on the whole the nights were calm.

In late July and early August it was extremely hazy in the Yarkand valley, so much so that details of the opposite banks, some eight hundred yards away, could only be distinguished with difficulty. This haze was probably caused by loess from the Taklamakan desert. It was also hazy in the Zug-Shaksgam towards the end of August. The elevation here was about 14,100, and it is believed that this was a heat haze.

In July there were periodical snowstorms, which after taking about three days to work up lasted only for a few hours, and in August there were two such spells of longer duration in the Aghil Depsang region. By September it had become much colder, the summer had passed, and it was evident that winter conditions were setting in. Although most of the month was free from snow or rain there were far more clouds. In the middle of the month snow fell lightly for about four days in the Lungmo-chhe, and the weather was worse in the neighbourhood of the head of the Shaksgam, where the snowfall was much heavier. The whole season appeared to be later than in 1914, floods beginning to come down the rivers early in August.

We were asked to observe the depth of snow at high altitudes, in order to supply data for determining whether the snowfall is greater above or below 20,000 feet. These observations were not recorded. The snow was examined on the passes, but as conditions varied greatly on every range accurate determinations could not be obtained. Snow on the passes was also in various stages of thaw according to the recent weather and the season of the visit, and it was impossible to tell whether it lay in drifts or not. On the Aghil range the permanent snow-line varies between 19,500 and 20,000 feet.

No fog occurred, and except near the periods of bad weather the air seemed to be generally dry. The succession of colours at sunrise and sunset was noted a few times. After leaving Leh only three thunderstorms were recorded, one on June 18th in the Nubra, the second north-east of the Depsang plains on June 27th, and the third to the north-east of the Amphitheatre on June 30th.

DAILY DIARY OF METEOROLOGICAL OBSERVATIONS

| Date | Place | Time | Clouds, Weather and Remarks |
|--------|-------------------|-------|---|
| May 11 | Gāndarbal | 12.30 | Cirrus clouds, but fine weather after a long spell of bad. Halo through cirrus. |
| 14 | Gund to Sōnamarg | noon | Fine since 11th. Halo through cirrus. |
| 16 | Bāltal to Matāyan | | Crossed Zōji La (11570 ft.) by night starting 11.15 p.m. Fine. Wind very variable in strength and direction, blowing alternately up and down gorge. |

| Date | Place | Time | Clouds, Weather and Remarks |
|--------|----------------------------|------------|--|
| May 17 | Matāyan to Drās | 8 a.m. | Faint coloured halo through cirrus. |
| | | 12.30 p.m. | Wind WSW. Cirro-cumulus clouds. White halo. |
| | | 5 p.m. | Wind very strong. Bad weather seen towards the Zōji La. Clear bright night at Drās. |
| 18 | Drās | 8 a.m. | Sky covered 7 with stratus; later alto-stratus, cirro-cumulus and cirrus. |
| | | 10 a.m. | Wind WSW 3; later variable, SW and W 4. |
| | | 2.30 p.m. | Sky overcast by heavy clouds covering peaks, (12,000-17,000 ft.) |
| | | 4 p.m. | Slight rain; Wind W 5. |
| | | 5 p.m. | Cleared. |
| | | sunset | Few stratus left; Wind W 3. |
| 19 | Drās to Shimsa Khārbu | 10.30 p.m. | Lunar halos no colours, through thin cirrus. |
| | | Sunrise | Clouds resting on hills, cleared by 7 a.m. |
| | | 7 a.m. | Cirrus 1. |
| | | 9 a.m. | Cirrus 3 W. very slow. |
| | | 10 a.m. | Prominent halo, with very clear colours through cirrus haze. Sky from then on clouded over with cumulus. |
| | | 6 p.m. | Clear but for thin cirrus covering most of sky. Wind SW 4 down valley in evening. |
| | | | |
| 20 | Shimsa Khārbu to Kargil | 8 a.m. | Clouds down to 11,000 feet. Rain fell most of the morning, but cleared off about noon. |
| | | 12.30 p.m. | Cumulus clouds with a few alto-cumulus. Two or three lines of very thin cirrus. |
| | | 1.20 p.m. | Cirrus WSW. |
| | | evening | Wind W all day. Cloudy and threatening. |

| Date | Place | Time | Clouds, Weather and Remarks |
|--------|--|-------------------|---|
| May 21 | Kargil to Mulbekh | 9.30 p.m. | Moon misty with slight halo. |
| | | 3 p.m. | Dull day throughout, clouds resting on the hills. Rain fell at intervals till 12.30. |
| | | 4 p.m. | Clear patches in sky, cirrus being visible through breaks in cumulus. Cirrus SW Slight sun halo. |
| | | evening | Two layers of cirrus in long lines, inclined to one another, but moving in same direction, from SW. Wind up valley all day. Fine and clear, but for a little cumulus near horizon. Very clear lunar halo. |
| 22 | Mulbekh to Bod Khārbu | Sunrise 7 a.m. | Fine and clear. Threatening clouds from W. Cirrus SW. Slight halo for two hours till obscured by lower clouds. |
| | | noon to 3 p.m. | Passing showers, Wind variable all day. |
| | | 5 p.m. | Clear evening. |
| 23 | Bod Khārbu to Lāmayūrū | morning | Clear except for much cumulus, On Fotu La (13,200 ft.) several hailstorms with very fine hail. Cumulus and semi-transparent sheet cloud at the same height. |
| | | evening | Clear and cloudless. |
| 24 | Lāmayūrū to Nurla (Indus Valley) | morning | Clear and fine without a vestige of cloud till noon, when little wisps of cloud appeared and disappeared. Gradually a few clouds formed, chiefly cumulus. |
| | | 4.45 p.m. | A few cirrus, W. |
| | | 7 p.m. | Clear. Wind variable all day, generally W. |

| Date | Place | Time | Clouds, Weather and Remarks |
|--------|-----------------------------------|--|---|
| May 25 | Nurla to Saspol (Indus Valley) | Morning 1.45 p.m. Evening | Identical with yesterday. Cirrus, W. Clear. Wind variable all day, generally W, <i>up</i> the valley. Wind reached force 5 about 3 p.m., but dropped towards evening. Lunar haze. |
| 26 | Saspul to Nimu (Indus Valley) | Early 8 a.m. 10 a.m. 3 p.m. 9.30 p.m. | Clear. Clouds mainly cirrus W. Wind WNW, 3-4. Low cirrus, W. Sun halo. Wind WNW, 5. The trees of a plantation at Nimu lean markedly to SE, showing that the prevailing wind is NW, <i>up</i> the valley. Quite calm, with very slight lunar halo. |
| 27 | Nimu to Leh (Indus Valley) | Early 10 a.m. 2.30 p.m. 6.45 p.m. 9 p.m. | Stratus clouds, 8. do. do. 9. Weather cold and dull. Strong wind, W, 6, dropping to 5, when it remained steady till evening. Cirrus WSW. Calm; clouds drifting across moon. |
| 28 | Leh | Morning 9 a.m. 1 p.m. 3 p.m. 10 p.m. | Fine, with cirrus, cirro-stratus and cumulus. Cirrus, W. Wind SSE, 3, getting stronger. Wind SSE, 7, diminished to 5-4, at 5 p.m. Wind dropped. Many clouds. |
| 29 | Leh | Morning 8 a.m. 8.30 a.m. 9 a.m. | Dull, cloudy. Patches of sunshine. Rain clouds gathered in Indus valley from NW. Sleet. Air temperature 37° C. (sling). |

| Date | Place | Time | Clouds, Weather and Remarks |
|--------|-------|---|--|
| May 30 | Leh | 9.30 a.m. | Light snow for $\frac{1}{2}$ hour. Storm passed eastwards. Afterwards a clear day with gentle wind, W. |
| | | Evening | Calm and almost cloudless. |
| 31 | Leh | Morning 9 a.m. 10 a.m. | Overcast day with patches of sunshine. No cirrus. Clouds mostly cumulus, but cirro-stratus in evening. Wind mild, from N to W. |
| June 1 | Leh | 2 p.m. | Clear, with a little cirrus. Cumulus forming. |
| | | Evening | Large cumulus banks, but still some cirrus, WSW. Wind, S1. Small cumulus clouds almost stationary. |
| | | | Wind, S 5. |
| | | | Sky began to clear. Wind, W2. |
| | | Morning 9 a.m. 2.30 p.m. 6.30 p.m. | Clear but for cirrus. Cirrus cleared. Wind, S 4. Cirrus, WNW. |
| | | Morning 11 a.m. Afternoon 5 p.m. 6.30 p.m. 7 p.m. 7.30 p.m. | Clear, few cirrus; gradually cumulus formed in W & SW. Large mass of cirrus, apparently from W, followed by cirro-stratus and later cumulus. Sky became overcast. Showers. Cirrus, WNW. Overcast. Clouds, 9. Wind S 3. Snow seemed to be thawing fast on the neighbouring hills. |
| 2 | Leh | 5 a.m. 8 a.m. | Light snowfall. Sunny but cloudy. Sky overcast during day, but clear in evening and night. |

| Date | Place | Time | Clouds, Weather and Remarks |
|--------|-------|-----------|---|
| June 4 | Leh | 10 a.m. | After perfectly clear morning, small clouds began to form over hills to W and SW. |
| | | 2 p.m. | Nearly whole sky overcast with clouds, which remained till after sunset. Very little wind all day. |
| 5 | Leh | 8 a.m. | After clear morning, small clouds began to form over hills to W and SW. |
| | | Noon | Sky nearly covered. |
| | | 4 p.m. | Slight clearing of cloud. |
| | | 5.30 p.m. | Clouds mostly cumulus, but also nimbus, cirro-cumulus and cirrus, WSW. Wind, W4. Clear night. |
| 6 | Leh | 6.30 a.m. | Dull overcast morning. Clouds, 9. |
| | | 8 a.m. | Clouds chiefly stratus which remained all day. |
| | | Afternoon | Passing showers in neighbourhood, though not actually at Leh. |
| | | 8 p.m. | Very cloudy and overcast. |
| | | 11 p.m. | Clear. Wind all day SW, never more than 4. |
| 7 | Leh | Morning | Bright with few clouds collecting later, W and SW. Sun shone at Leh nearly all day. Quite clear. |
| | | 7 p.m. | Morning wind SW, afternoon wind W; strength never more than 4. |
| 8 | Leh | 9 a.m. | After clear morning clouds began to form in SW and W, increasing as time went on. |
| | | 4.30 p.m. | Sky cleared slightly. |
| | | 6 p.m. | Cirrus, W. Cumulus NW. Wind WSW 3. |
| | | | Moderately clear night. |

| Date | Place | Time | Clouds, Weather and Remarks |
|--------|---|--|--|
| June 9 | Leh | | Clouds collected as usual but on the whole a clearer and finer day. No cirrus. Fine clear night. |
| 10 | Leh to Leh Polu, (15,250 ft.) | 11 a.m. Night | Clear and fine till 11 a.m. when small clouds appeared in the SW. Wind very variable <i>up</i> and <i>down</i> the valley, but generally <i>down</i> or NE. Clear, Wind <i>down</i> valley, 4-5. |
| 11 | Leh Polu | Morning 10 a.m. 1 p.m. 5 p.m. | Clear ; clouds appearing as yesterday. Wind <i>down</i> valley. Wind changed to <i>up</i> valley. Wind again <i>down</i> valley. Passing showers seen over hills to SW and S. Cirrus, W. |
| 12 | Leh Polu | Morning 7.30 p.m. 10 p.m. | As yesterday but clouds formed a little earlier. Wind blowing <i>down</i> valley nearly all day, NE 3-4. Wind, NE 5. Wind, NE 2. |
| 13 | Leh Polu to Khardung Polu (15,300 ft.) over Khardung La, (17,600 ft.) | Sunrise 10.30 a.m. to noon | Very clear. Earth shadow exceptionally prominent. In SW, colours from horizon, pale pink, merging to pale yellow, pale green, and overhead pale blue. As the sun rose, the pink rapidly disappeared. Summit of pass, wind still NE. North of pass, below crest, wind SW. A heavy storm seen apparently passing from west to east over Saser mountains east of Shyok-Nubra junction. |

| Date | Place | Time | Clouds, Weather and Remarks |
|---------|--|------------|--|
| June 14 | Khārdūng Polu | 8 a.m. | Wind NE 5 <i>up</i> valley. |
| | | 2 p.m. | Wind changed to SW, 2-3, down valley, and remained so till after dark. Cirrus SW by W. |
| | | 9.30 p.m. | Very fine day throughout, and very clear night. |
| 15 | Khārdūng Polu to Khārdūng (13,350 ft.) | 8.30 a.m. | Wind freshened, SW, 5-6. |
| | | 10.30 a.m. | Clouds began to collect. |
| | | 12.30 p.m. | Clouds 7, including cirrus, with slight halo. Wind variable till now when it settled NE 2 <i>up</i> valley, freshening to 5-6. |
| | | 2 p.m. | Clouds 9. A passing storm seen over Khārdūng La. |
| | | 7 p.m. | Wind S 6, <i>down</i> valley, with passing showers. |
| | | | Cirrus SW. |
| 16 | Khārdūng to Khalsar (10,600 ft.) Shyok Valley | 8 a.m. | Dry bulb 51°.5, Wet 38° (sling). Clouds mainly alto-cumulus, 8-9, with passing showers. |
| | | | No wind in Khārdūng ravine till 2 p.m., when NE <i>up</i> the valley. |
| | | 3 p.m. | Shyok valley, wind NW, 6, <i>up</i> valley with dust storms. |
| | | | A little rain fell at night. |
| 17 | Khalsar to Tegur (10,250 ft.) Nubra Valley | 8.15 a.m. | Dry bulb, 56°.5, wet 45°.5. Clouds 7, chiefly cumulus, cirro-cumulus, and cirrus, W. |
| | | 10.30 a.m. | Passing showers. Wind NW 4 <i>up</i> valley. In Nubra wind NW 4 <i>down</i> valley. Several sandstorms. |
| 18 | Tegur to Pānāmik, (10,600 ft.) | 8 a.m. | Cloudy night. |
| | | | Dry bulb 57°, wet 46°. Clouded over early with cumulus, though fine and warm. Later showers seen on mountains. |

| Date | Place | Time | Clouds, Weather and Remarks |
|---------|---|------------|---|
| June 19 | Pānāmik | 1 p.m. | Wind NW <i>down</i> Nubra valley. |
| | | 4 p.m. | Heavy rainstorm from Pānāmik to Shyok, chiefly on west side of Nubra valley, with thunder and a little lightning. |
| | | 5 p.m. | A tendency to clear. |
| | | 11 p.m. | Completely clouded over. |
| | | 11.30 a.m. | A lovely fine day, hotter than before. |
| | | 1 p.m. | Much cirrus W by S. Cumulus N. Pronounced sun-halo. No appreciable wind. |
| 20 | Pānāmik | | Almost completely clouded over. Wind sprang up NW <i>down</i> valley. Rain and sandstorms visible towards Nubra-Shyok junction. |
| | | 10 p.m. | Fairly clear night. |
| | | 8 a.m. | Dry bulb 56° , wet $45^{\circ} \cdot 5$. Morning fine but cloudy. |
| | | 1 p.m. | Clouds had increased; wind NW. |
| 21 | Pānāmik to Umlung (12,250 ft.) | 4 p.m. | Wind very variable. Heavy rain shower from SW. |
| | | 7.15 a.m. | Dry bulb 57° , wet 45° . Clouds, 10. Rain fell on hills and gradually down in valley. |
| | | 9.30 a.m. | Clearer for an hour. |
| | | 10.30 a.m. | Rain. |
| | | 12.30 p.m. | Clearer. Some cirrus SW. Rain falling in Nubra. |
| | | 3 p.m. | Heavy rain for an hour at Umlung. |
| | | 5.30 p.m. | Cirrus SW. |
| 22 | Umlung to Skyangpo-chhe (15,200 ft.) | 10 p.m. | Fairly clear night. |
| | | 7.5 a.m. | Dry bulb $42^{\circ} \cdot 5$, wet 39° . |
| | | 7.45 a.m. | Cirrus SW. Clouds 4. Halo. |
| | | 1 p.m. | Wind variable in morning. Snowstorm coming <i>up</i> valley, force 5. With one short break it continued for rest of day. |

| Date | Place | Time | Clouds, Weather and Remarks |
|---------|---|---|--|
| June 23 | Skyangpo-chhe | 7.15 a.m. | Dry bulb 35°, wet 28°. Clouds 6, cirro-cumulus, SW. |
| | | 6.30 p.m. | Wind nearly all day NE 4, except between 3 and 5 p.m. when it was SW, and at 5.30 p.m. when it was variable. Corona round the moon. |
| 24 | Skyangpo-chhe to Saser Brangsa (14,900 ft.) over Saser pass, (17,600 ft.) | 9 a.m. 1 p.m. 5 p.m. | Cirrus SW. Wind variable all morning. Wind SW, some snow. Rain and snowstorm. Bottom of the storm in Shyok river bed; top above the highest mountains. A storm of very striking appearance. |
| 25 | Saser Brangsa to Murgo (14,600 ft.) | 11 a.m. 2 p.m. 11 p.m. | Wind in narrow rocky gorge SW, 4 up. On Chong-tash plateau wind W 6. Heavy clouds noted over Saser La. Bright clear night with slight W wind down valley. |
| 26 | Murgo to "Burtsa" (15,400 ft.) | 6.45 a.m. 1 p.m. 2.30 p.m. 9.30 p.m. | Dry bulb 34°, wet 31°. A beautiful clear morning, hot in confined valley. No appreciable wind. Wind SW 4 up valley. Wind N 4 down valley Very clear night with no wind, |
| 27 | Burtsa to Dep- sang Camp (17,480 ft.) | 7.15 p.m. 10 a.m. 11 a.m. 1 p.m. | Dry bulb 34°, wet 31°. Clouds 9. Slight snow shower for about quarter hour. Later much finer. Clouds 7 mostly cumulus. Wind very variable up and down valley. Cirrus SW. Cumulus SW. Kizil Langar, 16,400 ft. Cirrus W and halo. Cumulus WSW. Wind variable. |

| Date | Place | Time | Clouds, Weather and Remarks |
|---------|--|------------|---|
| June 28 | Dep sang Camp to Karakoram "Polu" (17,200 ft.) | 2.30 p.m. | Depsang Plains, 17,680, wind WSW 5. Depsang nearly clear of snow but for few patches; ground fairly hard. Heavy nimbus clouds seen in E and NE. |
| | | 8.30 p.m. | Lightning in E and NE. Bright clear night. |
| | | 7.15 a.m. | Dry bulb 27°. Wet 25°.5. Slight snow shower from W. |
| | | 8 a.m. | Many clouds. Wind N 5. |
| | Karakoram Polu to Yarkand Amphitheatre (16,200 ft.) | 11.30 a.m. | Cold wind, W 5. Very clear cloudless night. |
| | | 7.15 a.m. | Dry bulb 22°, wet 20°. Beautiful fine morning with cirrus SW. |
| | | 8 a.m. | Clouds 5, cirro-cumulus, cirrus, and cumulus. |
| | | 11.45 a.m. | Halo. Cirrus SW. |
| | | 1.30 p.m. | Wind W 7 up valley. Then E 5 down. |
| | Amphitheatre | 5 p.m. | Wind W 5. |
| | | 5.30 p.m. | (Amphitheatre) Cirrus SW. Heavy bank of cumulus and nimbus in N. |
| | | 8 p.m. | Lightning, NE. |
| | | | Fine all day with cirrus and cumulus. |
| July 1 | Amphitheatre to Stream F. (17,200 ft.) | 2.45 p.m. | Cirrus SW. Halo for nearly two hours. Wind variable but generally SW. |
| | | 6 p.m. | Clear and almost cloudless night. |
| | Morning | | Beautiful and clear, but for cirrus and cumulus. |
| | | 10.45 a.m. | Cirrus SW. Cirro-cumulus SW. Cumulus SW by S. Wind SW 5 down, but variable. |

| Date | Place | Time | Clouds, Weather and Remarks |
|--------|--|-----------|---|
| July 2 | Stream F to valley H (17,500 ft.) over pass G (17,930 ft.) | 1 p.m. | Clouds thickened and light snow fell from SW, for three-quarters hour. Then sun broke through with slight halo. Temp. 33°. |
| | | 3.15 p.m. | Another snowstorm for $\frac{3}{4}$ hour from SW. |
| | | 7.30 a.m. | Dry bulb 32°, wet 25°. Clouds 7. Cirrus and cirro-cumulus, both SW. Halo for about one hour. Wind N 1. |
| | | 8.30 a.m. | Wind NW 5. |
| | | 10 a.m. | Wind W 5. In valley "H" wind too variable to record. The immediate vicinity of glaciers seems to make the wind variable. |
| | | 11 a.m. | Halo, visible since 9.30 a.m. disappeared with the cirrus, and cumulus formed. |
| 3 | Valley H to Depot Camp, (16,200 ft.) | | A beautiful day, no cirrus, but patches of cumulus generally from SW. Wind very variable in strength & direction. |
| 4 | Depot Camp | | Fine. No cirrus, but much cumulus. Wind generally W up valley. Dust storm in Shaksgam valley. |
| 5 | Depot Camp | | Fine. No cirrus. Less cumulus than yesterday, and collecting later. Wind W 4 up the Shaksgam and from the Kyagar glacier. Dust storm about 1 p.m. |

| Date | Place | Time | Clouds, Weather and Remarks |
|--------|--|-----------------------------|---|
| July 6 | Depot Camp to Kyagar Lake Camp, (15,850 ft.) | 7 a.m. Morning 1 p.m. | Dry bulb 25°, wet 21°·5. Wind variable. Wind W 5 and dust storm as yesterday. Ice was driven by wind to E end of lake. The whole day was cloudless except for a little at the base of K ² and Gasherbrum. |
| 7 | Kyagar glacier | Sunset | On glacier nearly all day. Not a cloud seen and no wind felt at all when on glacier. Sunset seen from ridge E of glacier. Earth shadow very clear, and in the W, the only colours, pale yellow and pale green. |
| 8 | Kyagar Lake Camp, (15,850 ft.) | Sunset | Fine and cloudless. Wind generally W 3-4. Clear with yellow-green sky, Earth shadow visible. |
| 9 | Kyagar Lake to Depot | 9 a.m. 10 a.m. Sunset | Fine. Wind E 2. Slight heat haze. Wind W 3. Earth shadow again very clear and sky yellow-green. |
| 10 | Depot to Kyagar Creek, (16,300 ft.) | 4 p.m. Sunset | Cloudless till evening. Wind very variable in side nala. On "Wild" stations on ridge E of glacier, wind W 6. Wind W 3. Clouds over K ² a brilliant gold against a pale yellow and green sky. Cirrus and cirro-stratus over Muztagh-Karakoram range, E of Teram Kangri. Cirrus turned pale pink and cirro-stratus mud-colour. Deep blue-purple earth-shadow very prominent, deeply contrasting with snow. |

| Date | Place | Time | Clouds, Weather and Remarks |
|---------|------------------------|---|--|
| July 11 | Kyagar Creek | Early morning 1 p.m. | Clouds 7. Cirro-cumulus and cumulus. During day gaps in clouds but high peaks generally covered. Clouds mostly W, fast. Wind W 6. |
| 12 | Kyagar Creek and Ridge | Early morning 10 a.m. 1 p.m. | Clouds 4, mostly cumulus with few cirrus. Wind 7 with bursts of 8, variable in direction, but strong all day. Clouds 6, approximately SW. Clouds heavy to S of Teram Kangri; Gasherbrums and K ² enveloped. Snow during night. |
| 13 | Kyagar Creek to Depot | Morning Afternoon 10.30 p.m. | Clouds 10. Slight covering of snow down to lowest hills. Occasional gleams of sunshine. Sleet and occasional sunshine. No halo or corona. Fairly clear. |
| 14 | Depot Camp | Early 8 a.m. 6 p.m. 8.40 p.m. | Snow. Snowing. Ground quite white, but sun tried to break through a little later. Weather clearing; ground clear of snow. Cumulus SW. |
| 15 | Depot to Kyagar Lake | Morning 10 a.m. Afternoon 8 p.m. | Fine and clear. Cumulus collected. Wind W 5. Wind dropped. A fine clear night. |
| 16 | Kyagar Ridge | Sunrise | Sunrise on Gasherbrum magnificent. Snow peak against deep blue earth-shadow gradually became yellow pink. No wind. |

| Date | Place | Time | Clouds, Weather and Remarks |
|---------|---|--|--|
| | | Afternoon | Wind SW 7-8, dropping at sunset. Except for a few small clouds round base of K ³ most of the day, sky cloudless. About this time we realised that strong winds sprang up on fine days from the glaciated regions of the Muztāgh-Karakoram range. |
| July 17 | Depot | | Another splendid day. No particular observations made, except wind W in afternoon, and a few clouds at sunset. |
| 18 | Depot | 8 a.m. | Light snow, weather turning worse. |
| | | Afternoon 6.45 p.m. | Snowing. Weather cleared, cirro-stratus SW, with halo. Temperature 35°.5F. |
| 19 | Depot | 8-11 a.m. Afternoon 7 p.m. | Snow. Sky overcast. A little sunshine and cumulus. Dirty weather W, clearer to E. Very little wind all day. |
| 20 | Depot to Valley H Camp 17,200 ft. | 7.45 a.m. 9.30 a.m. 12.45 p.m. 3 p.m. 6 p.m. | Overcast. Dry bulb 34°. Clouds began to clear and sun to shine. Cirro-cumulus SW. A heavy bank of clouds to NE. Wind SW 4, dropping in evening. Heavy bank of clouds to NE. |
| 21 | Camp 17,200 to Yārkand Valley Camp 16,800 ft. | 7.45 a.m. 9.30 a.m. Afternoon | Dry bulb 31°, wet 27°.5. Clouds 8. Clouds cleared a little. Wind SW 5. |
| 22 | Camp 16,800 to Camp 16,200 ft. Yārkand Valley | 8 a.m. | A very bright warm morning. Small cumulus clouds 4, lasting all day. Wind variable. |

| Date | Place | Time | Clouds, Weather and Remarks |
|---------|--|-----------|--|
| July 23 | Camp 16,200 ft. Yarkand Valley | Afternoon | Wind SW 4. Calm clear night. |
| | | Sunset | No clouds till noon when a few cumulus appeared in NE. A beautiful day; wind steady SW 4-5. Wind dropped. Clear calm night with a few clouds in SE. |
| 24 | Camp 16,200 to Camp 15,800 ft., Yarkand Valley | 7 a.m. | Dry bulb 41°, wet 31°. Clouds 0. |
| | | 9.30 a.m. | Clouds 3, Cumulus, which remained all day. From daybreak to about 10 a.m. very thick mist probably loess from Central Asia. Wind variable, but tendency in afternoon to SW 4-5. Clouds in far NW, probably stratus. |
| 25 | Yarkand Valley to Lungmo-chhe Camp 15,200 ft. | Sunset | Very clear night. |
| | | 7 a.m. | Clouds 0. Very thick haze, almost amounting to fog. There appeared to be dust, (probably loess) in it, and it was thicker in NW. |
| 26 | Lungmo-chhe Camp 15,200 ft., to Advanced Base Camp, 17,200 ft. | 3 p.m. | Haze partly cleared. No halo or corona. Wind SW 5 dropping to 2 after dark. Clouds, cumulus, 4, all day. Very clear night. |
| | | 7.30 a.m. | Haze as yesterday in NE, in Yarkand valley. Clouds 1 increasing to 4, cumulus. |
| 27 | Advanced Base Lungmo-chhe 17,200 ft. | Afternoon | Wind SW 5, dropping at sunset to 2. |
| | | 7 a.m. | Clouds 9, Cumulus, some down to 17,500 ft. Cleared to 7 later. Wind mostly SW 3, increasing to 5 between noon and 2 p.m. |

| Date | Place | Time | Clouds, Weather and Remarks |
|---------|--|---|--|
| July 28 | Advanced Base Lungmo-chhe 17,200 ft. | | A fine day with much cumulus. Very clear evening. |
| 29 | Do. Do. | 9 a.m. 4-5 p.m. 7.15 p.m. | Clouds 1, later 0. Small patches of cirrus, W. Clouds 0. Wind SW 3. A very fine day. |
| 30 | Do. Do. | 9 a.m. 10 a.m. 10.15 a.m. 1 p.m. | Clouds 1. Cirrus, two layers, both WSW. The top layer caused a halo. Clouds 3, nearly all cirrus. Halo of 22° with cirrus haze continued all morning, being exceptionally bright at 11.15. Cirrus cleared. A very fine day, with wind throughout SW 5. Fairly clear night. (Conditions approximately same in Sa Lungpa). |
| 31 | Do. Do. | 9 a.m. Afternoon 6.30 p.m. 8.30 p.m. | Fine morning. Clouds 5, cumulus, but above the whole sky covered with cirrus haze. Halo visible lasting about an hour; top very bright, both sides faint. Top and bottom approximately 22° from sun, sides approximately 30°. Beneath the halo an inverted arc. Morning wind variable in direction, 1. Clouds 10. Wind SW 2-3. Clouds 7, cirrus WSW, Cirro- cumulus WSW, cumulus and lenticular-shaped cumulus stationary, Strato-cumulus NW. Snowing. (Conditions approximately the same in Sa Lungpa). |

| Date | Place | Time | Clouds, Weather and Remarks |
|--------|--|-----------------------------|---|
| Aug. 1 | Advanced Base Lungmo-chhe 17,200 ft. | 9 a.m. 11 a.m. 5 p.m. | Snow ceased. Clouds 10. Clouds 7. Clouds 10. Snowing. Wind variable between SE and N, generally NE 4. (A very snowy day in the Sa Lungpa, with a dirty windy night.) |
| 2 | Advanced Base Short reco. down valley and back | 7 p.m. | Dull grey morning. Valley under snow. Snowing hard. (In Sa Lungpa, snow, sleet, rain and lastly snow again). |
| 3 | Advanced Base | | Fine day with cumulus. snow thawed. (In Sa Lungpa, fine but cloudy. Clouds cleared from Gasherbrum in evening). |
| 4 | Down Lungmo-chhe to Camp 16,000 ft. | | Very fine; scarcely a cloud all day. (Fine in Sa Lungpa). |
| 5 | Same Camp Exploration by "Low Col" to narrow tributary gorge of "J" Valley | | Cloudless throughout except for one small cloud at 3 p.m. Wind variable in the narrow valley. Evening clear with very little wind. (Fine in NW branch of Sa Lungpa.) |
| 6 | Same camp | Morning | Wind S 2-3. Cloudless till noon when few cirro-cumulus cloudlets formed, direction NW. |
| | | Afternoon | Wind S 5-6. (Fine at Aghil Depsang). |

| Date | Place | Time | Clouds, Weather and Remarks |
|--------|--|---|--|
| Aug. 7 | Up valley to Camp 16,800 (New Base) | Morning | Heavy haze, cloudless till noon when a cumulus bank formed in NE. |
| | | Afternoon | Wind SW 5, dropping by 5 p.m. to 2. (Fine on Aghil Depsang; few clouds after sunset). |
| 8 | New Base | Morning 9 a.m. 10 a.m. 2 p.m. 5.30 p.m. | Very fine. Clouds 0. Wind NE 2. Clouds 2. Wind SW. 3. Clouds 4, all in N and NE. Wind SW 4. Clouds 4. A heavy bank in NE, and cirrus W in S and SW. Wind SW 4. (On Aghil Depsang very cloudy all day). |
| 9 | New Base | 9 a.m. 10 a.m. 11 a.m. Afternoon 9 p.m. | Fine. Clouds 0. Wind NE 3. Clouds 4, all in N and NE. Rainstorms seen in lower Lungmo-chhe. Clouds 7. Very dull and windy. Rain and snowstorms coming from NE. Fairly clear but some clouds. Wind dropped. (On Aghil Depsang very cloudy; by late afternoon sky completely overcast and sleet fell. Very squally). |
| 10 | New Base | | No special observations today. (On Aghil Depsang: Snow stopped about 1 a.m. and wind changed to W. Fine day, with heavy haze hang- ing over hills to north of the plateau). |
| 11 | Down Lungmo- chhe to Camp 16,000 ft. | 8 a.m. | Very thick haze. Wind NE 2. Clouds 3 all cirro-cumulus. |

| Date | Place | Time | Clouds, Weather and Remarks |
|---------|--|------------|--|
| Aug. 12 | Down Lungmo-chhe to Camp 15,800 ft. | 9 a.m. | Wind NE 4. Very cold. |
| | | 11 a.m. | Clouds 6, all cumulus. Very warm. Dry bulb 62°. Wind 0. |
| | | 2 p.m. | Clouds 8. Wind S 4. Rainstorms seen in Yarkand valley. |
| | | 3.45 p.m. | Rather clearer in S. Cirrus W. |
| | | 5 p.m. | Clouds 7, all cumulus. Wind N 2. Dull. |
| | | 6 p.m. | Clouds 9. Wind NE 5. (On Tatar La: generally clear to NE, N, NW, and over nearer ranges to S. Gasherbrum and K ² almost completely hidden from an early hour, swathed in cloud. Very cloudy at night). |
| | | 8 a.m. | Clouds 10. Wind NE 4. Slight snow. |
| | | 10 a.m. | Clouds breaking up everywhere. |
| | | Noon | Some sunshine. |
| | | 2.45 p.m. | Heavy rain and hail for 1/4 hour. |
| | | 3.30 p.m. | Dull. Wind SW 2. Clouds 8. (Tatar La: snow during morning, and dismal all day till after sunset). |
| 13 | Over Watershed to north of Lungmo-chhe, to Tributary of “J” Valley, Camp 16,800 ft. | 9 a.m. | Clouds 0. Wind SE 2. In the narrow tributary wind variable. |
| | | 3 p.m. | Clouds 4, Cirro-cumulus. Clear night. (Tatar La: a perfect cloudless day. K ² and Gasherbrum quite clear). |
| 14 | Back to Lungmo-chhe Valley Camp 16,000 ft. | 8 a.m. | Clouds 1, all cirrus W. Slight halo. Wind NW 1. |
| | | 10.30 a.m. | Clouds 7, nearly all cirrus, very high and thin. Very bright halo. Bank of cirro-stratus to S. Wind NE 4. |

| Date | Place | Time | Clouds, Weather and Remarks |
|---------|-----------------------------------|-------------|---|
| | | Noon | Clouds 5, various. Slight halo. Wind SE 3. |
| | | 3.15 p.m. | Clouds 6, various. Cirrus W. Cumulus stationary. Wind S 4. |
| | | 3.50 p.m. | Much cirrus haze. Slight halo with mock sun on left side. |
| | | 5.30 p.m. | Clouds 10. Very dull. Raining in upper Lungmo-chhe. |
| | | 7-9.30 p.m. | Wind S with very strong gusts. Clouds 10. |
| | | 9.30 p.m. | Very cloudy; a few faint stars. (In Tatar Lungpa and West col: 7 a.m. fine but rapidly clouding. K ² and Broad peak disappeared by 9. Brilliant halo about noon through thick cirrus. Heavy clouds in afternoon. Snow at sunset.) |
| Aug. 15 | Camp 16,000 ft. | 8 a.m. | Clouds 10. Wind NE 4. Very dull. Light snow. |
| | | 10.30 a.m. | Clouds 8. |
| | | 1 p.m. | (On high hill). Clouds 10. Light snow. Wind NE 4, gusty. Bad weather in all directions. Rain E and W; clearer to N. |
| | | 5.30 p.m. | Clouds 8, more broken. Wind NE 3. (Tatar La Camp: Snowing all morning with heavy clouds. Partially cleared in afternoon). |
| 16 | Camp 16,000 to Camp 16,200 ft. | 8 a.m. | Very dull. Clouds 10. Wind NE 3. |
| | | 1 p.m. | Clouds 7. Wind NE 2. Warm and fine. |
| | | 3 p.m. | Light snow showers. |
| | | 6.30 p.m. | Clouds 6. Wind NE 5. Very cold. Snow and rain showers in NE. |

| Date | Place | Time | Clouds, Weather and Remarks |
|---------|-------------------------------------|------------|---|
| | | | (Tatar La Camp: Snow showers off and on all day). |
| Aug. 17 | Camp 16,200 ft. | 8 a.m. | Very misty, though sun shining. Occasional very light snow showers during day. (Tatar La Camp: Intermittent snowstorms all day with heavy clouds). |
| 18 | Camp 16,200 to New Base, 16,800 ft. | | Very misty in morning, partly clearing in afternoon. Otherwise fine. (Tatar La Camp: Very cloudy all morning with occasional snow. Cleared in afternoon.) |
| 19 | New Base | 7.30 p.m. | As yesterday till evening. Wind NE. Raining. (Kalmuk Lungpa: Fine all day with only a few clouds. Very hazy). |
| 20 | New Base | 8.30 a.m. | Very misty. Clouds 7. Wind NE2. Heavy misty cumulus clouds all day. |
| | | Sunset | Clouds more broken up, with a few cirrus about. Sunset yellow. (Zug-Shaksgam, 14,100 ft.: Fine but very hazy, the opposite side of the valley being often invisible. No view of higher hills). |
| 21 | New Base | 10.30 a.m. | Misty but less so than last few days. Wind E 4. Clouds 5. |
| | | 1 p.m. | Wind SW 4. Clouds 5. |
| | | 3 p.m. | Wind SW 4. Heavy bank of clouds in NE, otherwise fine. |
| | | 5.30 p.m. | Clouds 3, all cirrus W, except in NE, where small patch of cumulus remained. Wind SW 3. |

| Date | Place | Time | Clouds, Weather and Remarks |
|---------|--------------------------------|------------|--|
| Aug. 22 | New Base | 6.30 p.m. | Dry bulb 49°. A fine night with few clouds. (Zug-Shaksgam: Very hot day, with thick haze obscuring the hills and valley till 3 p.m., when wind changed from approx. N to S, and haze cleared). |
| | | 9 a.m. | Dry Bulb 49.5°. Clear morning. No mist. Clouds 1. Wind SE 1. |
| 23 | Over Marpo La to Shaksgam | Afternoon | Heavy bank of cumulus in NE. Clouds never more than 4 all day. Wind variable all day between SE and SW, generally SE in morning and SW in afternoon; force about 6 all day. (Zug-Shaksgam: Fine and clear of mist; afternoon cloudy. Night, very cloudy and stormy with high gale). |
| | | 5 a.m. | Clouds down to 19,000 ft. on hilltops. |
| | | 6 a.m. | Clouds nil. |
| | | 10 a.m. | A few cumulus. |
| | | 5 p.m. | A few cirrus low down on SE horizon. |
| | | Sunset | Clear and yellowish green. Earth Shadow very prominent. (Zug-shaksgam: Fine and generally clear). |
| 24 | Back over Marpo La to New Base | 7.30 a.m. | Clouds 6, mostly cirrus, approx. W, and cirro-stratus, SE. Faint halo. Wind 0. |
| | | 10.30 a.m. | Clouds 6, cirro-cumulus, cirro-stratus, and cirrus. Wind SW 3. |
| | | Noon | Wind SW 5. |
| | | 3 p.m. | Wind SW 6-7. |

| Date | Place | Time | Clouds, Weather and Remarks |
|---------|----------|------------|---|
| | | 5 p.m. | Clouds 5, cirrus W, cirro-stratus, and cumulus WSW. Wind SW 5. Snow fell during night from NE. (Zug-Shaksgam: Cloudy most of the day. Wild evening with high gale at 9.15 p.m. Snow began to fall 10.30 p.m.) |
| Aug. 25 | New Base | 8 a.m. | Snow lying. Clouds 0. Dry bulb, 37° , wet 32° . |
| | | 10 a.m. | Clouds 1, cirrus W. Wind S 3. |
| | | 1 p.m. | Clouds 3, cirro-cumulus. Wind SW 5. |
| | | 5 p.m. | Clouds 0. Wind SW 3. |
| | | 6 p.m. | Clouds 0. Wind NE 4. Dry bulb, 41.5° , wet 30.5° . |
| | | 10.30 p.m. | Very clear moonlight night. Wind 0. Very cold. (Zug-Shaksgam: Snow lying down to 14,400 ft. Fine, crisp and almost cloudless day). |
| 26 | Do. Do. | 8.30 a.m. | Dry bulb 37.5° , wet 32° . Not a cloud all day. Wind mostly SW but never strong. Fine clear night. No wind. A little warmer than last night. (Zug-Shaksgam: Fine). |
| 27 | Do. Do. | | Cloudless and calm all day. (Kalmuk Lungpa: Fine and cloudless). |
| 28 | Do. Do. | 9 a.m. | Clouds 0. Bright morning but slight mist. |
| | | 10 a.m. | Clouds 3. Wind SW 4, remaining so for some hours. |
| | | 2 p.m. | Wind SW 6. |
| | | 5 p.m. | Clouds 5, chiefly in NE. Wind SW 5. |

| Date | Place | Time | Clouds, Weather and Remarks |
|---------|----------|------------------------|---|
| Aug. 29 | New Base | 7 p.m. | Clouds 5. Wind puffy and variable. Mist and low clouds in NE. (Tatar La: Fine). |
| | | 9 a.m. | Fine, slight mist. |
| | | Afternoon | Heavy bank of strato-cumulus in NE. Wind SW 5 and clouds 4 nearly all day till evening, chiefly cumulus and cirrocumulus. |
| | | 6.30 p.m. 8.30 p.m. | Wind ENE 5. Clouds 6. Fine clear cold night. Wind E 5, up valley. (Aghil Depsang: Fine). |
| 30 | Do. Do. | 9 a.m. | Beautifully fine morning with slight mist. Clouds 0, wind E 1. |
| | | 1 p.m. | Clouds 1, cirrus W. Wind NE 4. (Sa Lungpa: Fine). |
| 31 | Do. Do. | 9 a.m. | Fine but slight mist. Clouds 6, cumulus. Wind NE 4. Clouds varied between 5 and 9, wind steady NE, varying between 3 and 6 all day till evening. |
| | | 4 p.m. | Very slight and short snow shower. |
| | | 5.15 p.m. | Clouds 8, cirrus W, cirrostratus and cumulus E, very slow. Wind NE 6. |
| | | 7 p.m. | Clouds 10. Wind NE 6. |
| | | 9.45 p.m. | Clouds 2. Wind nil. (Sa Lungpa: Fine, but clouded up a lot in afternoon). |
| Sept. 1 | Do. Do. | 9 a.m. | Clouds 5. Cumulo-stratus in E and NE. A little cirrus W, and cirro-cumulus W by S. Wind NE 3. Misty. |

| Date | Place | Time | Clouds, Weather and Remarks |
|---------|----------|------------|--|
| Sept. 2 | New Base | 1 p.m. | Very dull. Clouds 10. Wind E. 1. |
| | | 6 p.m. | Very dull. Clouds 10. Wind NE 4. |
| | | 10.30 p.m. | Rather cloudy. Wind nil. |
| | | 9 a.m. | Fine but misty. Clouds 1. Wind NE 1. |
| | Do. Do. | 3 p.m. | Wind SE 2. Clouds 5, cumulus. For a short time between 3 and 4.30, wind SW 4, then NE 4. |
| | | 7 p.m. | Clouds 8. Wind NE 1. |
| | | | Very fine morning. Slight haze. Wind all day 3-6. |
| | Do. Do. | 1 p.m. | Clouds 3, cumulus. Fine clear windless night. |
| | | 9 a.m. | Clouds 0. Wind NE 1. Slight haze. |
| | | 12.30 p.m. | Clouds 4. Wind SW 5. |
| | | 3.30 p.m. | Clouds 2, cirro-stratus, all in NE. Wind SW 3. |
| | Do. Do. | 6.30 p.m. | Clouds 2, cirro-stratus, and cumulus all in NE. Wind SW 1. |
| | | 9 a.m. | Clouds 0. Wind 0. |
| | | 10 a.m. | Clouds 2, cumulus. Wind NE 2. |
| | | 2 p.m. | Clouds 3, cumulus. Wind SW 6. |
| | | 6 p.m. | Clouds 4, cumulus SE, cirrocumulus and cirrus W very slow. Wind NE 3. |
| | | 10 p.m. | Cloudy night. Wind 0. |
| 6 | Do. Do. | 2 a.m. | A little snowfall for half an hour. |
| | | 8.30 a.m. | Clouds 7 cumulus, cirrocumulus, and stratus, some down to 19,000 ft. Wind 0. |
| | | Noon | Clouds 9. Wind SW 4. Gloomy in SW. |

| Date | Place | Time | Clouds, Weather and Remarks |
|---------|---|-------------------|---|
| Sept. 7 | New Base to Camp 16,000 ft. Lungmo-chhe | 1.30 p.m. | A few local showers from SW. Some sunshine. |
| | | 4.30 p.m. | Clouds 10. Wind NE 4. |
| | | 6.45 p.m. | Clouds 10. Wind NE 4. |
| | | 9.30 p.m. | Steady drizzle. |
| | | 8.30 a.m. | Clouds 7 down to 18,000 ft., broken but with a fair amount of sunshine. Wind NE 4. |
| | | 11 a.m. | Clouds 10. Wind NE 4. |
| | | 2.30 p.m. | Clouds 6, nearly all cumulus; some cirrus, approx. W. Wind SW 3. |
| | | 4.30 p.m. | Clouds 5, massive cumulus with nimbus in NE. Rain over Yarkand river. |
| | | 6.45 p.m. | Clouds 5, cumulus. Wind N 6. |
| | | 10.30 p.m. | Clouds 10. Wind N 4. Steady drizzle. |
| 8 | Camp 16,000 ft. Lungmo-chhe | 8.30 a.m. | Clouds down to 17,000 ft., rising during the day. Wind generally N. |
| | | Evening | Rain. |
| 9 | Camp 16,000 ft. Lungmo-chhe | 8.30 a.m. | Clouds down to 18,000 ft. rising later. |
| | | Evening 9 p.m. | Finer with cirrus approx. W. Wind N 4. Low clouds in N; otherwise clear night. |
| 10 | Do. Do. | 8.30 a.m. | Clouds 7, down to 18,500 ft., rising later. Wind NE 3. |
| | | 1 p.m. | Clouds 5. Wind SW 6. |
| | | 6 p.m. | Clouds 3. Wind SW 5. |
| 11 | Do. Do. | 8.30 a.m. | Clouds 3. A fine day generally with much cumulus. Wind SW 6-7, nearly all day. |
| 12 | Do. Do. | 8 a.m. | Clouds 5, cumulus down to 19,000 ft. Wind NE 1. |

| Date | Place | Time | Clouds, Weather and Remarks |
|----------|--|------------|---|
| | | 9 a.m. | Clouds 5, well above hills. |
| Sept. 13 | Camp 16,000 ft. to Camp 15,800 ft. Lungmo-chhe | Noon | Clouds 1. Wind SW 4. |
| | | 4 p.m. | Clouds 3. Wind SW 6. |
| | | 9.30 p.m. | Clear night. Clouds 0. Wind SW 1. |
| | | 8 a.m. | Clouds 3. Wind NE 1. |
| | | 11 a.m. | Clouds 4. Wind NE 3. |
| | | Noon | Clouds 4. Wind NE 3. |
| | | 2 p.m. | Clouds 3. Wind SW 3. |
| | | 6.30 p.m. | Clouds 0. Wind SW 4. |
| | | Sunset | Fine and clear; pale yellow on N horizon. |
| | | 9.30 p.m. | Fine night. Clouds 0. Wind SW 2. |
| 14 | Camp 15,800 ft. Lungmo-chhe | 9 a.m. | Clouds 0. Wind NE 2. |
| | | 10 a.m. | Clouds 0. Wind NE 3. |
| | | 11.30 a.m. | Clouds 0. Wind SW 3. |
| | | 1 p.m. | Clouds 0. Wind SW 5. |
| | | 4 p.m. | Clouds 0. Wind SW 7. |
| | | 7 p.m. | Clouds 0. Wind SW 4. |
| | | | Clear fine night. Clouds 0. Wind SW 3. |
| | | | |
| 15 | Do. Do. | 7.30 a.m. | Clouds 1, cumulus in SW. Wind SW 4. |
| | | 9 a.m. | Clouds 3. Wind SW 5. |
| | | 11 a.m. | Clouds 5. Wind SW 7. Clouds chiefly in SW, cumulus and stratus. Appearance of dirty weather coming up. |
| 16 | To Yarkand Valley Camp 15,500 ft. | 8 a.m. | Cloud 7. Wind SW 5. |
| | | 11 a.m.- | Clouds 10; but sun dimly shining through. Wind variable but never stronger than 4. Very like a late autumn day in England. Occasional flakes of snow. |
| | | 5 p.m. | Clouds much thinner, and blue sky appearing. |
| | | 6 p.m. | Clouds 4. Wind E 3. |
| | | 9.30 p.m. | Fine clear night. Clouds 0. Wind NW 1. |
| | | | |
| | | | |

| Date | Place | Time | Clouds, Weather and Remarks |
|----------|--|---|--|
| Sept. 17 | Camp 15,500 ft. | 9 a.m. 11 a.m. 9.30 p.m. | Clouds 1. Wind E 3. Clouds 3. Wind SE 5, remaining much the same all day. Very cold SE wind. Fine cloudless windless night. |
| 18 | Do. Do. | 8 a.m. 9 a.m. 11.30 a.m. 4 p.m. 6.30 p.m. | Clouds 0. Wind 0. Clouds 2. Wind SE 3. Clouds 3. Wind SE 5. Clouds 3. Wind SE 5. Clouds 1. Wind SW 3. |
| 19 | Do. Do. | 9 a.m. 2 p.m. 4 p.m. 9 p.m. | Clouds 0. Wind 0 till noon. Clouds 0. Wind SE 4. Clouds 0. Wind SE 5. Clouds 0. Wind SE 2. |
| 20 | To 15,800 ft. Yarkand River | | Fine, but a few clouds and wind mostly E and SE. |
| 21 | Camp 15,800 ft. | | As yesterday. |
| 22 | To Camp 16,000 ft. Yarkand River | 9.15 a.m. 3 p.m. 9.30 p.m. | Clouds 5, mostly stratus and cirro-cumulus, in W and N; but a little cirrus W. Wind E 1, later veering to SE 4. Wind S 6. A heavy bank of clouds in N, otherwise clear. Wind inappreciable. |
| 23 | To Amphitheatre, 16,200 ft. Yarkand Valley | Early 8 a.m. 9 a.m. 9 p.m. | Snow. Snow lying everywhere. Clouds down to 17,000 ft. Weather gradually clearing. A few cirrus W, with very slight halo. Much cirro-cumulus, cirro-stratus and stratus all day, with local snowstorms. Between 11 a.m. and 5 p.m. wind SW 6 and very cold. Clear except for heavy bank of clouds in N. Wind N 2. |

| Date | Place | Time | Clouds, Weather and Remarks |
|----------|---|---|---|
| Sept. 24 | Amphitheatre | 9 a.m. | Early morning snow. Snow lying everywhere. Cold dull day with low clouds. Sleet and snow all day, though a little finer in after- noon. More local snow showers in evening. |
| 25 | To Camp 17,000 ft., Lungpa Ngonpo | 9 a.m. Noon Afternoon 9 p.m. • | Clouds stratus, 9. Snow threatening. Wind NE 1. Clouds 8. Wind 3. Wind variable. Apparently much finer in E than in W. Fine clear night. Clouds 0. Wind inappreciable. |
| 26 | To Daulat-Beg- oldi | 9 a.m. 2 p.m. 3.30 p.m. Sunset | Clouds 3 wind 0, gradually increasing to E 5, very cold and bitter. On crossing the Kadpa Ngonpo La wind SE 5. Wind NW 4. Wind variable. On reaching Daulat-Beg-oldi wind definitely W 6, from Rimo glacier. Wind dropped. Clouds about 5, mostly cumulus. Rather dirty-looking weather in Rimo direction. |
| 27 | To Kizil Langar | 8.30 a.m. 10 a.m. 11.30 a.m. Afternoon | Clouds 1, mostly cumulus in W. Wind 0. Clouds 6. Wind SE 3. Clouds 8, cumulus. Wind W 3 which soon increased to W 5. Clouds about 5. Wind W varying in strength. |
| 28 | To "Burtsa" | | Cloudless all day. Wind sprang up about 10 a.m. being up the valley all day, generally SE 3-5. |

| Date | Place | Time | Clouds, Weather and Remarks |
|----------|--------------------------------|-----------|--|
| Sept. 29 | To Murgo | | Another cloudless day. No wind till Murgo was reached in afternoon, and then W 5. Clear night. Wind W 3. |
| 30 | To Saser Brangsa | 9.30 p.m. | Cloudless throughout. Wind started about 10 a.m. W 5, from Saser La direction, and remained so all day. Windy night. |
| Oct. 1 | To Skyangpo-chhe over Saser La | 8 a.m. | Wind still W. 4. Fine cloudless all day with wind W 3-6. |
| 2 | To Nubra Valley | | Wind W 3-5 all day. Cloudless till 6 p.m., when a few cumulus were visible, particularly at head of Nubra valley. |
| 3 | To Pānāmik | | Clouds about 4 all day, cumulus. Wind SE 3-4. |
| 4-11 | Pānāmik to Leh | | Continuous fine weather, many of the days being absolutely cloudless. |

ABSTRACT OF CIRRUS CLOUD OBSERVATIONS

| Date | Time | Place | No. of Obs. | Direction | Remarks |
|---------|-----------|----------------------|-------------|-----------|--------------------------------|
| 19-5-26 | 8.10 a.m. | 1 mile East of Drās | 2 | W.N.W. | |
| „ | 9.0 a.m. | 4 miles East of Drās | 3 | W. | Very slow. |
| 19-5-26 | 10.0 a.m. | 6 miles East of Drās | 2 | W. | Movement almost imperceptible. |
| „ | 6.15 p.m. | Shimsa Kharbu | 3 | W. | |

| Date | Time | Place | No. of Obs. | Direction | Remarks |
|---------|------------------------|-----------------------------|-------------------|---------------|---|
| 20-5-26 | 1.20 p.m. | Kargil | 3 | W.S.W. | Cumulus and alto-cumulus were SW. |
| 21-5-26 | 3.0 p.m. & 4.0 p.m. | Moulbekh | 6 | S.W. | 2 layers, both SW. Cirrocumulus SW & cumulus NNW. |
| 22-5-26 | 7.0 a.m. | 1 mile East of Moulbekh | 3 | S.W. | |
| 24-5-26 | 4.45 p.m. | Nurla | 3 | W. | Cumulus WNW. |
| 25-5-26 | 1.45 p.m. | Saspul | 3 | W. | |
| 26-5-26 | 8.0 a.m. | 3 miles East of Saspul | 3 | W. | |
| , | 10.0 a.m. | 7 miles East of Saspul | 4 | W. | |
| 27-5-26 | 6.45 p.m. | Leh | 2 | W.S.W. | |
| 28-5-26 | 9.0 a.m. | Leh | | W. | |
| 31-5-26 | 10.0 a.m. | Leh | 3 | W.S.W. | |
| 1-6-26 | 6.30 p.m. | Leh | 4 | W.N.W. | |
| 2-6-26 | 6.30 p.m. | Leh | 4 | | |
| 5-6-26 | 5.30 p.m. | Leh | 5 | W.S.W. | |
| 8-6-26 | 6.0 p.m. | Leh | 3 | W. | Cumulus NW. |
| 11-6-26 | 5.0 p.m. | Leh Polu | 3 | W. | |
| 14-6-26 | 2.0 p.m. | Khardüng Polu | 5 | S.W. by W. | Cumulus W. |
| 15-6-26 | 7.0 p.m. | Khardüng | 3 | S.W. | Movement almost imperceptible. |
| 17-6-26 | 10.0 a.m. | 2½ miles NW of Khalsar | 3 | Approx. W. | Only taken with a walking stick & fixed point. Very fast. |
| 19-6-26 | 11.30 a.m. | Pānāmik | 6 | W. by S. | Very slow. Cumulus were N |
| 21-6-26 | 12.30 a.m. | 8 miles North of Pānāmik | 2 | S.W. | |
| 22-6-26 | 7.45 a.m. | Umlung | 3 | S.W. | |
| 24-6-26 | 9.0 a.m. | Saser La | 3 | S.W. | |

| Date | Time | Place | No. of Obs. | Direction | Remarks |
|---------|------------|------------------------------------|-------------------|-----------|---|
| 27-6-26 | 11.0 a.m. | 5 miles S of Dep-sang Plains | 3 | S.W. | Cumulus SW. |
| " | 1.0 p.m. | Kizil Langar | 6 | W. | Cumulus WSW. |
| 29-6-26 | 7.30 a.m. | 6 miles SE of Karakoram La | 2 | S.W. | Very slow. |
| " | 11.45 a.m. | 3 miles W of Karakoram La | 4 | S.W. | Cumulus WSW. |
| " | 5.30 p.m. | Amphitheatre Yarkand River | 4 | S.W. | |
| 30-6-26 | 2.45 p.m. | Ditto | 2 | S.W. | |
| 1-7-26 | 10.45 a.m. | Between amphitheatre and Stream F. | 2 | S.W. | Cirro-cumulus SW. |
| 2-7-26 | 7.30 a.m. | Near Stream F. | 4 | S.W. | Cumulus SW by S. |
| 18-7-26 | 6.45 p.m. | Shaksgam Depot | 2 | S.W. | Cirro-Cumulus SW. |
| 20-7-26 | 12.45 p.m. | Upper Shaksgam | 2 | S.W. | These were cirro-stratus. |
| 29-7-26 | 4.30 p.m. | Lungmo-chhe | 4 | W. | These were cirro-cumulus. |
| | | | | | They lasted for about 1 hour, & then clear. |
| 30-7-26 | 10.0 a.m. | Lungmo-chhe | 5 | W.S.W. | 2 layers, both WSW. |
| 31-7-26 | 6.30 p.m. | Lungmo-chhe | 6 | W.S.W. | Cirro-cumulus WSW. |
| | | | | | Cumulus practically stationary. |
| | | | | | Strato-cumulus NW. |
| 8-8-26 | 5.30 p.m. | Lungmo-chhe | 3 | W. | |
| 11-8-26 | 3.45 p.m. | Lungmo-chhe | 2 | W. | |
| 14-8-26 | 8.0 a.m. | Low Col Stream | 2 | W. | |
| 14-8-26 | 10.30 a.m. | " | 4 | W. | |
| " | 3.15 p.m. | Lungmo-chhe | 2 | W. | |
| 21-8-26 | 5.30 p.m. | " | 3 | W. | |

| Date | Time | Place | No. of Obs. | Direction | Remarks |
|----------|----------------------|---------------|-------------------|---------------|---------------------------|
| 24-8-26 | 5.0 p.m. | Lungmo-chhe | 3 | W. | Cumulus WSW. |
| 25-8-26 | 10.0 a.m. | " | 3 | W. | |
| 30-8-26 | 1.0 p.m. | " | 2 | W. | |
| " | 5.0 p.m. | " | 2 | W. | |
| 31-8-26 | 5.15 p.m. | " | 4 | W. | Cumulus E. Very slow. |
| 1-9-26 | 9.0 a.m. | " | 3 | W. | Cirro - cumulus W by S. |
| 5-9-26 | 6.0 p.m. | " | 4 | W. | Very slow. Cumulus SE. |
| 22-9-26 | 9.15 a.m. | Yarkand River | 2 | W. | |
| 23-9-26 | 9.0 a.m. | " | 2 | W. | Very slow. |
| 15-10-26 | 6.0 a.m.— 11 a.m. | Leh | | Approx. W. | |

APPENDICES

I

RATIONS AND SUPPLIES

The following were the scales of daily rations and fodder arranged for and issued during the expedition :—
Pathans and Kashmir Muhammadans (five), each :—

| | | | | |
|--------------------------------|-----|-----|-----------------------|----------------------|
| Wheat <i>Ata</i> | ... | ... | $\frac{1}{2}$ seer | (1 lb.) |
| Rice & <i>Dall</i> | ... | ... | $\frac{1}{2}$ seer | (1 lb.) |
| Salt | ... | ... | $\frac{1}{2}$ chittak | ($\frac{1}{2}$ oz.) |
| <i>Ghi</i> (clarified butter.) | ... | 1 | chittak | (2 oz.) |
| Sugar | ... | ... | 1 chittak | (2 oz.) |
| Tea | ... | ... | $\frac{1}{2}$ chittak | ($\frac{1}{2}$ oz.) |

Occasional fresh meat when available.

Gurkha Sepoys (three), each :

| | | | | |
|------------------|-----|-----|--------------------------|----------------------|
| Wheat <i>Ata</i> | ... | ... | 6 chittaks | (12 oz.) |
| Rice | ... | ... | 6 chittaks | (12 oz.) |
| <i>Dall</i> | ... | ... | 1 $\frac{1}{2}$ chittaks | (3 oz.) |
| <i>Ghi</i> | ... | ... | 1 chittak | (2 oz.) |
| Salt | ... | ... | $\frac{1}{2}$ chittak | ($\frac{1}{2}$ oz.) |
| Sugar | ... | ... | $\frac{1}{2}$ chittak | (1 oz.) |
| Tea | ... | ... | $\frac{1}{2}$ chittak | ($\frac{1}{2}$ oz.) |

Occasional fresh meat when available.

Muhammadan pony-men (7), Muhammadan porters (3), Buddhist porters (22), (includes caravanbashi & head porter), each :—

| | | | | |
|--------------------|-----|-----|-----------------------|----------------------|
| Barley <i>Satu</i> | ... | ... | $\frac{1}{2}$ seer | (1 lb.) |
| Wheat <i>Ata</i> | ... | ... | $\frac{1}{2}$ seer | (1 lb.) |
| Tea | ... | ... | $\frac{1}{2}$ chittak | ($\frac{1}{2}$ oz.) |
| Butter | ... | ... | 1 chittak | (2 oz.) |
| Salt | ... | ... | $\frac{1}{2}$ chittak | (1 oz.) |
| Sugar | ... | ... | $\frac{1}{2}$ chittak | (1 oz.) |
| Tobacco | ... | ... | $\frac{1}{2}$ chittak | (1 oz.) |

Occasional fresh meat when available.

Baggage ponies, (21), each :—

| | | | | |
|--------|-----|-----|---------|----------|
| Barley | ... | ... | 2 seers | (4 lbs.) |
|--------|-----|-----|---------|----------|

Total rations and fodder required after Pānāmik, exclusive of requirements for British officers and temporary caravan, weighed approximately eight tons.

Supplies, mainly tinned, for the British officers, were bought from the Army & Navy Co-operative Society, London ; they were packed in three-ply wooden boxes, each weighing 56 lbs. when full. Variation of diet was considered in the selection of food. There were three types of boxes :—

Type A. Six boxes arranged for the journey from Srinagar to Pānāmik and back, each approximately to last four officers for a fortnight. These allowed for local purchase of meat, eggs, vegetables, flour and milk.

Type B. Twenty-four boxes each arranged to last four officers for five days, for the period of the exploration beyond Pānāmik. With a small addition from reserve, they were made suitable for two officers for ten days. They allowed for no local purchase but were supplemented in Kashmir by additional supplies of flour, sugar and butter.

Type C. Four boxes of sauces, occasional luxuries, &c.

There were also four boxes in reserve. and one box containing 20 lbs. of tobacco.

II

WARM CLOTHING AND EQUIPMENT

Warm clothing. The following articles of clothing were issued to all followers :—

| | |
|-----------------------|--|
| 1 Balaclava cap | 1 poshteen (sheepskin coat) |
| 1 woollen jersey | 2 pairs <i>Pabboos</i> (or 1 pair Boots) |
| 1 pair woollen gloves | 3 Blankets (or 1 Numdah and 1 Blanket) |
| 2 pairs woollen socks | 1 warm puggarie |
| 1 <i>puttoo</i> suit | 1 pair puttees |

This scale was found adequate. The felt numdah was issued instead of two blankets and was more suitable. Soft leather *pabboos* are more suitable for Ladakhis than boots ; the two pairs just lasted during the expedition with careful mending, the skin of dead horses being used for this purpose. Gurkhas, Kashmiris and Pathans preferred boots which were suitable for them. Boots must be carefully fitted.

Officers equipped themselves approximately to the following scale :—

| | |
|----------------------|--------------------------------|
| 2 warm vests | 2 <i>puttoo</i> or tweed suits |
| 2 warm pants | 1 pr. shorts |
| 1 cotton pants | 1 pr. grey flannel trousers |
| 3 prs. stockings | 3 shirts |
| 6 prs. woollen socks | 1 sweater |
| 1 pr. puttees | 1 poshteen |

| | |
|------------------------|-------------------|
| 2 pr. gloves | 1 pr. slippers |
| 1 Balaclava cap | 2 prs. pyjamas |
| 1 woollen muffler | 1 sun helmet |
| 1 pr. climbing boots | 12 handkerchiefs |
| 1 pr. ammunition boots | 1 bath towel |
| 1 pr. Gilgit boots | 2 face towels |
| 3 prs. <i>chaplis</i> | Toilet requisites |

Tents. Followers were accommodated in Bell-tents, specially made by the Elgin Mills, Cawnpore. Twelve men could sleep in each tent, if necessary. Each tent weighed 60 lbs. complete with poles, pegs, and bag and they were very good.

The Council of the Royal Geographical Society presented three Everest pattern Whymper tents, with double flys. These were very strong and light, and withstood some very high winds; they were made by Messrs. Benjamin Edgington. Each weighed 58 lbs. complete with poles, metal pegs, and bag. At the end of the expedition they were almost as good as new.

Eiderdown quilted sleeping bags, made by the same firm and presented by the Royal Geographical Society were used throughout the expedition. They were admirable in every way, the patent slip fasteners being an excellent innovation.

Fuel. Meta Fuel was used as a reserve fuel, and was employed at high camps and bivouacs. It fulfilled all the claims of its makers and was invaluable.

Rifles and guns. Two twelve-bore shot guns and two .375 Mannlicher-Schonauer rifles, with three hundred cartridges for the former and two hundred for the latter were taken; also one small collecting gun.

III

TRANSPORT NOTES

For a journey to Central Asia from Leh, it is always difficult to decide whether to hire or to purchase ponies at Leh. Probably if one is present in Leh after the trading season has begun, after the beginning of July, it is better to buy, but time is always necessary in order to strike bargains. Owing to our very early start, I advanced money to my caravanbashi to buy animals, and ordered him to buy them if possible a month before our arrival at Leh so that they could be well fed before we began to work them. I then intended to hire this transport from him.

This plan was not satisfactory. Most of the ponies were bought a month before our arrival, and when Clifford examined them at Leh at the end of June, they were, with one or two exceptions, a good looking lot of animals. We then found, however, that the caravanbashi did not wish to take the risk of losing them in the Shaksgam,

and being unable to come to reasonable terms of hire, we took them over from him at cost price.

The purchase price of the ponies varied very greatly from Rs. 62/- to Rs. 156/-. But the more expensive animals were no fitter for the expedition than the cheaper ones. The following table gives a summary of the cost, casualties and sale price after the expedition.

| No. | Date of purchase | Purchase price | Disposal | Sale price |
|-----|------------------|----------------|--|------------|
| | | Rs. | | Rs. |
| 1 | 20-4-26 | 156 | Died. Altitude exhaustion | ... |
| 2 | " | 84 | " Pneumonia | ... |
| 3 | " | 111 | " Exposure to blizzard | ... |
| 4 | " | 69 | Sold. Very weak | 25 |
| 5 | " | 76 | " Lame | 40 |
| 6 | " | 97 | Died. } Exposure, exhaus- 7 29-4-26 151 } tion and lack of " " " } grass | ... |
| 8 | 29-4-26 | 76 | " } Exposure to bliz- | |
| 9 | 30-4-26 | 87 | " } zard | ... |
| 10 | " | 73 | Sold. | 50 |
| 11 | " | 81 | " | 70 |
| 12 | 4-5-26 | 62 | Died. Exhaustion | ... |
| 13 | 5-5-26 | 101 | Sold. Very weak | 25 |
| 14 | 9-5-26 | 156 | " | 115 |
| 15 | 6-5-26 | 111 | Died. Heart failure | ... |
| 16 | 9-5-26 | 81 | Sold. | 70 |
| 17 | 11-5-26 | 73 | Died. Colic | ... |
| 18 | " | 121 | Sold. Weak | 60 |
| 19 | 29-5-26 | 76 | " " | 40 |
| 20 | 4-6-26 | 71 | " | 40 |
| 21 | " | 88 | " | 55 |
| | | Rs. 1996 | 10 died. 11 sold. | Rs. 590 |

Personnel. One caravanbashi (Rs. 50 p. m.) and 7 Muhammadan pony-men (Rs. 25 p. m.) were required for these animals. They were given warm clothing and free rations according to the scales in Appendices I and II. The caravanbashi was too inexperienced for his duties, but any of the pony-men should make a good caravanbashi in future.

The porters were mostly selected from the neighbourhood of Khalatse, in the Indus valley. Without exception they were first-

class men. They came quite willingly for Rs. 20/- a month with rations and warm clothing. They were placed under the charge of our shikari, Kunchuk, who was excellent man in every way. The following is a complete list of our pony-men and porters:—

| | | |
|-----|---|--------------|
| 1. | Ahmad Akhun of Leh | Caravanbashi |
| 2. | Ghulam Shah, s/o Ahmad Shah, of Leh | Pony-man |
| 3. | Ibrahim, s/o Siddik, of Chushot | " |
| 4. | Habibullah, s/o Raju Khan, of Leh | " |
| 5. | Abdul Razak, s/o Ghulam Mhd., of Leh | " |
| 6. | Abdul Samad, s/o Ramzan, of Leh | " |
| 7. | Sabu Malik, s/o Samad Malik, of Stok | " |
| 8. | Ghulam, s/o Rasul, of Tegur | " |
| 9. | Kunchuk, s/o Rabzang of Phyang, Shikari & head-porter | |
| 10. | Nima Tundup, s/o Chanpen Chuk, of Timis | Porter |
| 11. | Tashi I, s/o Tanzin Lunduf, of Timis | " |
| 12. | Punchuk I, s/o Nancho, of Timis | " |
| 13. | Tashi Punchuk, s/o Tashi, of Timis | " |
| 14. | Bande, s/o Namdul, of Timis | " |
| 15. | Sewang Rapgis, s/o Orgiang, of Timis | " |
| 16. | Zapgish, s/o Manla Tunduf, of Timis | " |
| 17. | Kunzan, s/o Lupzan Tanzin, of Timis | " |
| 18. | Sitan Punchuk, s/o Chasgul, of Timis | " |
| 19. | Sanam Lunduf, s/o Sanam Punchuk, of Timis | " |
| 20. | Tashi II, s/o Sanam Punchuk, of Timis | " |
| 21. | Punchuk II, s/o Siring Durje, of Timis | " |
| 22. | Sanam Tarjis, s/o Lupzang Tanzin, of Timis | " |
| 23. | Sewang Punchuk, s/o Chotak, of Timis | " |
| 24. | Sanam Tashi, s/o Tashi Gaonfild, of Timis | " |
| 25. | Tunduf Siring, s/o Sanain Punchuk, of Timis | " |
| 26. | Tunduf, s/o Palchung, of Timis | " |
| 27. | Sewang Tashi, s/o Siring Umchuk, of Tia | " |
| 28. | Tashi Murup, s/o Tunduf, of Tia | " |
| 29. | Siring II, s/o Urgiand, of Tia | " |
| 30. | Aziz, s/o Hassan, of She | " |
| 31. | Tashi Pulju, s/o Ghulam Punchuk of Timorang | " |
| 32. | Sultan, s/o Samad Ghani, of Leh | " |
| 33. | Ghulam Khadir, s/o Rasul, of Leh | " |

I had considered the possible use of yaks, camels and sheep as transport animals for the expedition. The first are not available for sale early in the year, and probably would not be fit enough. They are of course excellent on snow, but they do not carry loads well in single file or in defiles, and I do not think they would have been as good as ponies. Camels I could not get, and they would be useless for crossing glaciers. Sheep for transport must be of the right type and very fit at the commencement of a journey. They will only take loads in sacks, and they also are accustomed to travel in herds rather than in single file. They are more suitable for the open

plateaus of the Lingzi-thang than for gorge country. Yaks, camels and particularly sheep would however have suffered less from the lack of grass than did our ponies.

If I had the selection of transport for such an expedition again, I should use a temporary caravan of ponies to take me to the Shaksgam, but I should rely entirely on porters for the exploration.

Temporary Caravan. The rate for hire of animals,—known as *Res* on the trade-route—is an anna a mile as far as Pānāmik, and I kept rigidly to this rate to that place. For the large caravan of temporary animals from Pānāmik to the Shaksgam, which I anticipated would occupy a fortnight's travel each way through desolate and almost grassless country, I fixed a contract rate at Rs. 37/- per animal, inclusive of hire of pony-men. These men had to arrange for their own food and for the extra animals required for the carriage of it. I bought the fodder required for all animals and issued it to the pony-men daily, deducting the cost price from the wages of each man, when he was paid off. Risk of loss was accepted by the owners on these terms, and they were content.

I had intended to despatch every second or third day the surplus ponies back to Pānāmik. The batches to be returned at various places were previously selected. Owing to casualties among the animals we could not maintain this programme, and were compelled to leave a few ponies at each camping spot where there was grass, before they could face the return journey.

With the minor exception of the trouble on the Saser pass, the temporary caravan worked very well under their contract, and one of the men, Ali of Hondar in the Shyok Valley, returned punctually to Wood's Amphitheatre to bring us back at the end of the expedition.

IV

GEOGRAPHICAL NAMES

Colonel Burrard remarks in his *Sketch of the Geography and Geology of the Himalaya Mountains and Tibet*: “The nomenclature of a mountain region should not be forced: it should grow spontaneously, and we should never invent a name until its absence has become inconvenient.” In the area of our explorations there were but two names in existence, the *Shaksgam valley* and the *Aghil range*. The absence of names was inconvenient, and something had to be done about it.

Colonel Wood's system on our east margin was to employ the alphabet: though he expressly stated that the letters he used were to be considered provisional, yet in all the correspondence before our expedition these letters had to be used. The tendency is therefore for provisional names, whatever one may say to the contrary, to become

permanent. The symbol K², for the second highest mountain in the world was used first in Colonel Montgomerie's angle book, and it has remained for seventy years.

Our own system was an attempt to follow Colonel Burrard's principle; and we encouraged our men to name places. It is interesting to note that they never named a single mountain, and the names they gave to passes and valleys had to be dragged out of them. I am however convinced that these names mean something definite to them, and the alphabet does not. On our return to Leh, we called one of our men before Mr. Kunick of the Moravian Mission and one of his native pastors. Each name was reconsidered, and its derivation and suitability investigated. The resulting names are given below. All are in Ladakhi, which is a dialect of Tibetan. I would add that along the trade-route, both Ladakhi and Turki names are used indiscriminately, and I am adding at the end some of the Ladakhi names used on the trade-route, with their meanings, as far as we could ascertain.

Ladakhi names applied to the area of our explorations.

Kyagar Thso, "The Grey-white Lake." (Deriv. *Kya* or *skya*, grey; *gar* or *kar* white.)

Kyagar Kangri, "The Kyagar Glacier." The word *Kang-ri* means "ice mountain." To the uneducated native mind, a large glacier is an ice mountain, and the peak at its head merely a protuberance at one end of the mountain. As *Kang-ri* is used by educated Tibetans and Europeans to denote mountains and not glaciers (e. g. Aling Kangri, Teram Kangri), it would lead to confusion if we were to use "Kyagar Kangri" for the glacier. I therefore use the expression "Kyagar glacier." (In this connection, the old name for the Siachen glacier is "Saichar Ghainri. I believe this is really "Siachen Kangri," which was the name given me in Panamik for this glacier.)

Marpo La, "The Red Pass." (Deriv. *Marpo*, Red.)

Lungpa Marpo, "The Red Ravine" or "Valley." *Lungpa* is placed first by the men for euphony.

Lungmo-chhe, "The Big Valley." (The word "chhe" is a suffix, derived from "*chheremo*" meaning "big." Strictly the valley should probably be "*Lungpa chhenmo*." But for euphony, we were told, a Ladakhi would always use the suffix, and convert the noun into its feminine form.) This is Wood's valley "I."

Sa-Kang La, "The Earth and Ice Pass." (Deriv. *Sa*, earth; *Kang*, ice.) This pass, at the head of the Lungmo-chhe, consists of two convergent saddle glaciers whose snouts join but whose trunks are separated by a tongue of land.

Sa Lungpa, "The Valley of Earth," or "Mud." The slopes

and valley bottom were covered with a layer of mud. Shaksgam itself appears to mean either "The Box of Pebbles," or "The Dry Pebbles." (Deriv. *Shak*(-*ma*), pebbles; *Gam* or *sgam*, box, or possibly *kam* or *skam*, dry.)

Zug-Shaksgam, "The False Shaksgam."

Dizma La. *Dizma* seems to mean "many coloured." The rocks on this pass were of a mauve and violet tint.

Kadpa-ngonpo La, "The Blue Rift Pass." (Deriv. *Kadpa*, rift or quarry; *Ngonpo*, blue.) This pass lies close to the Karakoram pass and at the head of Wood's valley "A." Near the pass there is a blue scar from a fall of the hill-side. I have used the word *Lungpa Nyonpo* ("The Blue Valley") for valley "A."

The Aghil Depsang, the Tatar Lungpa, the Tatar La, and the Kalmuk Lungpa were named by us without reference to our men.

Names on the Trade-route.

Pang-dang-sa, "The Grassy Plain." (Deriv. *Pang* or *Spang*, turf; *dang* or *thang*, plain; *sa*, earth, ground.) A camping-ground for caravans west of the Saser pass.

Skyangpo-chhe, "The Great Wild-Ass." (Deriv. *Skyang* or *Kyang*, wild ass; *po*, male; *chhe*, big, see above under Lungmo-chhe.) A camping-ground west of the Saser pass.

Mamo-stong, "The Thousand Demons." (The spelling on old maps *Murgisthang* seems to me to be incorrect. We were told that a legend existed that a large number of "bad men" from Central Asia were killed by an avalanche on the Mamostong glacier, and that the derivation was *Mamo*, demons; *stong*, thousand.)

Ang-kar-shak Meaning doubtful; derivation seems to be *Ang* (-*gyag*), junction of ice and the mountain side; *gar* or *kar* (-*po*), white; *shak* (-*ma*), pebbles. The meaning may be "a moraine," for the trade-route here traverses a moraine west of the Saser pass.

Bong-ro-chan, "The Place of the Dead Ass." (Deriv. *Bong* (-*bu*), a baggage ass; *ro*, a corpse; *chan*, having.) A locality just west of the Saser pass.

Sa-ser, "Yellow Ground." (Deriv. *sa*, earth, ground; *ser*, yellow.) The name is given first to a spot in the upper Shyok, and from this the pass becomes the "Saser La."

Depsang, "The Open Plateau." (Deriv. *Deps* or *Ideps*, elevated plain; *sang* or *sangsang*, open, clear.)

The spelling for the glacier explored by the De Filippi expedition should undoubtedly be "Rimo," not "Remo." There appears to be no word in either Turki or Ladakhi, with the *Raymo* sound.

Rimo, in Ladakhi means either a picture, band, or stripe. It is also possible that the word is merely a feminine form of the word *Ri*, a mountain. The assistants in the Survey of India at the time of the Kashmir survey, 1855-1864, spelt the names exactly as they sounded in English.

The initial 's' before the consonants 'g' 'k' and 'p', which I believe is always silent in Eastern Tibetan, is generally pronounced by the Ladakhi. It is certainly used in *Shak-sgam*, *Skyangpo-chhe*, *Spitok*, Skärdü. We found the silent variant in the words, *sKyagar* *sPang-dang-sa*. The aspirated 'h' is noticeable in *Ladakh* in such words as *Thso*, *chhemmo*.

The Ladakhi does not seem to have a great number of topographical terms in common use; and he does not discriminate much between a ravine and an open valley. He seems more concerned with how the word appeals to his sense of hearing. He may use the word *Trokpa*, which literally means a mountain brook, for quite a large tributary; and he will use the word *Lungpa* (or its feminine form, *Lunymo*, if he chooses), which is more strictly a fairly large tributary, to denote a brook. The word *Lartsa*, which means literally "the foot of a pass," is generally used for the *camping-ground* at the foot. But *Pulo*, which actually means a "shelter hut," seems to be used regardless of whether there is a hut or not. *Brangsa*, a "camping-ground," is also sometimes loosely used instead of *Lartsa* or *Pulo*, though it generally appears more often away from the immediate vicinity of passes.

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